

ULTIMATE GUIDE TO GAME STREAMING

At home, in the cloud, all
you need to know **PG. 36**



SUPERCHARGED NVIDIA GTX 970

Zotac's Amp cranks up
the clockspeeds **PG. 72**



SAMSUNG'S 3D SSD REVOLUTION

Hot new 850 EVO drive
in the labs **PG. 74**



MAXIMUM PC

MINIMUM BS • FEBRUARY 2015 • www.maximumpc.com

LAPTOP VS DESKTOP

EIGHT TESTS, ONLY ONE WINNER...



Future

REVIEWED! GAMING HOTNESS

Far Cry 4 • Assassin's
Creed Unity • Call of
Duty: Advanced Warfare



GRAPHITE SERIES

760T

FULL-TOWER PC CASE

DRAM

Stability under pressure that's the result of superior engineering and fanatical screening for performance and reliability.


PSUs

Stable, reliable power with a focus on high output, energy efficiency, and ease of installation.


COOLING

Efficient, quiet cooling with zero maintenance and simple setup makes it easy to protect your CPU.


FANS

Physics meets design in a line of case fans that work better, and look better, too.


CORSAIR LINK™

Comprehensive monitoring and control for high-performance PCs.


USB 3.0 FLASH DRIVES

High-speed data storage in rugged designs lets you safely take your data with you.

Uniquely Gorgeous. Uniquely Cool.



The stunning new Graphite Series™ 760T is the world's first performance PC case with panoramic windowed side panels that are hinged for easy access and secured with discreet, flush-mounted latches. Inside, there's room for multiple full-sized GPUs and the sophisticated cooling you'll need to build a truly state of the art system. Each drive mount is tool free and every drive cage is modular, so you can customize your 760T to fit your exact needs.

Your PC deserves to look as good as it performs.

Learn lots more at corsair.com/graphite-series



MOBILE WIRELESS STORAGE

The Voyager Air™ family lets you enjoy all your videos, music and photos wherever you go.



SSDs

Amazing storage performance that will improve the speed of virtually everything you do with your PC.



KEYBOARDS

Flexible and ergonomic designs, highly customizable and built with quality components for superior key feel.



MICE

Precision gaming tools that help you play your best ... whether it's professionally, or you're just playing to win.



HEADSETS

Accurate audio reproduction for compelling gaming and the situational awareness you need for a competitive edge.

iBUYPOWER Recommends Windows® 8



Customizable

GAMER PALADIN D837

\$999

Intel® Core™ i5 4690
Gigabyte® GA-Z97-D3H MB
NVIDIA® GeForce™ GTX 760 2GB VC
8GB DDR3-1600 Corsair Memory
24X DVD±RW | 128 GB SSD + 1TB SATA III HDD
ARC 647 Gaming Case + 600 W Power Supply
Windows® 8.1 64-Bit



Customizable

CHIMERA CX9

\$1199

Intel® Core™ i7 4710HQ
NVIDIA® GeForce™ GTX 860M 4GB VC
17.3" Full HD Anti-Glare 1920x1080 (16:9)
8GB DDR3-1600 Memory
DVD±RW | 1TB 7200 RPM HDD
15.6" Full HD 1920x1080 IPS LED-Backlit Display
Windows® 8.1



Customizable

GAMER PALADIN D859

\$1569

Intel® Core™ i7 5820K
Gigabyte® GA-X99-UD4 MB
NVIDIA® GeForce™ GTX 970 2GB VC
8GB DDR4-2400 Corsair Memory
24X DVD±RW | 256GB SSD | 1TB SATA III HDD
Corsair 230T Case + 600 W Power Supply
Windows® 8.1 64-Bit

Doublelift from Counter Logic Gaming
Professional eSports Player



**EVERYTHING ELSE
COMES SECOND**



**REVOLT
R0507**

Customizable

\$699

Intel® Core™ i3 4150

ASRock® B85M-ITX MB

NVIDIA® GeForce™ GTX 750 2GB VC

8GB DDR3-1600 Corsair Memory

SLIM DVD±RW | 1TB 7200 RPM HDD

Revolt Case + 250W Power Supply

Windows® 8.1 64-Bit

Call Us: 888-462-3899

Customize Online:
ibuypower.com



iBUYPOWER



inside

FEBRUARY 2015

QUICKSTART

- 12 THE NEWS**
Super 10TB SSDs on the way; Intel joins Google Glass; SSDs live 1,000 years; Criminals improve grammar.
- 18 THE LIST**
Free hardware-monitoring tools.
- 20 TALKING TECH**
Gordon's farewell means rants about Apple, *Star Wars*, and much more.

Check your Nvidia GPU with EVGA Precision X.



R&D

- 58 AUTOPSY**
Taking apart the Google Nexus 9.
- 61 HOW TO**
Customize Windows 8.1; fix your ultra-widescreen woes.
- 66 BUILD IT**
We go to town with an eight-core Intel CPU, three GeForce GTX 980 video cards, and a new Samsung SSD.

LETTERS

- 22 DOCTOR**
- 94 COMMENTS**

FEATURES 26



26 LAPTOP VS. DESKTOP

Laptops have come a hell of a long way, but can they really replace your desktop?

36 STREAMING SUPERSTARS

Become an instant expert with this in-depth guide to all things game streaming.

50 THE STATE OF PLAY

The global gaming industry is booming, but could it be heading for another crash?

IN THE LAB



72 ZOTAC GTX 970 AMP EXTREME EDITION



78 OCZ ARC 100 240GB



80 SCYTHE MUGEN MAX



86 FAR CRY 4

FIT FOR A CHAMPION



The **POSEIDON Z** Illuminated Keyboard Series

- Fully Back-Lit
- Tt eSPORTS Certified Switches
- **5** Year Warranty
- Multi Key Rollover

See the full line up at ttesports.com



Tt[®]
eSPORTS
By Thermaltake

CyberPower recommends Windows



CYBERPOWERPC

[Create The PC of Your Dreams]



Gamer Xtreme XT

Windows 8.1

GIGABYTE® X99 Chipset Mainboard
CORSAIR® 16GB DDR4 2400MHz Quad Channel Memory
2TB SATA III 6.0 7200RPM HD 32MB Cache
Nvidia® GeForce® GTX 970 4GB Direct X 11 Video Card
Zalman Gaming Headset
Corsaire 300R Gaming case with 600 Watt 80+ Power
Asetek Liquid Cooling System

Intel® Core™ i7 Processor

Extreme 5960X 3.00Ghz \$ 2235

5930K 3.50Ghz \$ 1735

5820K 3.30Ghz \$ 1545

From

\$ 1545

Blu-ray 14x	
HD 7.1 600 W	
CoolerMaster®	
CoolerMaster®	



Zeus Mini-I 200

Windows 8.1

GIGABYTE® B85 ITX Mainboard w/ USB 3.0 & SATA 6
CORSAIR® 8GB DDR3 1600 Mhz Dual Channel Memory
1TB SATA III 3.0 7200 RPM HD 16MB Cache
Nvidia® GeForce® GTX 750 1GB Video Card
Zalman Gaming Headset
CyberpowerPC Zeus Mini-ITX Gaming Case 350 Watt

Intel® Core™ i7 Processor

4790K 4.00Ghz \$ 909

4790 3.60Ghz \$ 869

Intel® Core™ i5 Processor

4690K 3.40Ghz \$ 799

4690 3.50Ghz \$ 775

4590 3.30Ghz \$ 755

4460 3.20Ghz \$ 745

Intel® Core™ i3 Processor

4360 3.70Ghz \$ 709

4150 3.50Ghz \$ 679

From

\$ 679

Case 8X ± RW
HD 7.1 600 W
CoolerMaster®
CoolerMaster®



Unleash The Power

[Your Unlimited Gaming Solutions]

Explore new ways to learn and stay connected with Intel Inside®.



Gamer Infinity 8800 Pro SE Windows 8.1

GIGABYTE® X99 Chipset Mainboard
CORSAIR® 32GB DDR4 2400MHz Quad Channel Memory
256 GB SATA III SSD Boot Drive
2TB SATA III DATA Hard Drive
Nvidia® GeForce® GTX 780 4GB Video
Zalman Gaming Headset
Thermaltake Core V71 Full Tower Case 800 Watt 80+ Power
Asetek Liquid Cooling System

From **\$2129**

Blu-ray 14x	FREE Liquid Cooling
HD 7.1 600 W	
CoolerMaster®	
CoolerMaster®	

Intel® Core™ i7 Processor

Extreme 5960X 3.00Ghz \$ 2815
5930K 3.50Ghz \$ 2325
5820K 3.30Ghz \$ 2129

Intel® Core™ i7 Processor
4790K 4.00Ghz \$ 1089
4790 3.60Ghz \$ 969
Intel® Core™ i5 Processor
4690K 3.40Ghz \$ 899
4690 3.50Ghz \$ 875
4590 3.30Ghz \$ 855
4460 3.20Ghz \$ 845
Intel® Core™ i3 Processor
4360 3.70Ghz \$ 809
4150 3.50Ghz \$ 779

Gamer Xtreme 2000

Windows 8.1
GIGABYTE® GA-Z97 Mainboard w/ USB 3.0 & SATA 6
CORSAIR® 8GB DDR3 1600 Mhz Dual Channel Memory
2TB SATA III 7200 RPM HD
Nvidia® GeForce® GTX 750Ti 2GB Video Card
Zalman Gaming Headset
Nzxt Source 340 Gaming Tower Case
430 Watt 80+ Power
Asetek Liquid Cooling System



24X ± RW	FREE Liquid Cooling
HD 7.1 600 W	
CoolerMaster®	
CoolerMaster®	

From **\$779**



Intel® Core™ i7 Processor
4790K 4.00Ghz \$ 1225
4790 3.60Ghz \$ 1175
Intel® Core™ i5 Processor
4690K 3.40Ghz \$ 1119
4690 3.50Ghz \$ 1099
4590 3.30Ghz \$ 1075
4460 3.20Ghz \$ 1065
Intel® Core™ i3 Processor
4360 3.70Ghz \$ 1029
4150 3.50Ghz \$ 989

Gamer Xtreme 3000

Windows 8.1
GIGABYTE® GA-Z97 Mainboard w/ USB 3.0 & SATA 6
CORSAIR® 16GB DDR3 1600 Mhz Dual Channel Memory
2TB SATA-III 6.0 7200 RPM HD
Nvidia® GeForce® GTX 760 2GB Video
CFI X-Nova with 600Watts 80+ Power
Asetek Liquid Cooling System

Blu-ray 14x	FREE Liquid Cooling
HD 7.1 600 W	
CoolerMaster®	
CoolerMaster®	

From **\$989**

Intel® Core™ i7 Processor
Extreme Edition
4940XM \$2359
4910MQ \$1809
4810MQ \$1579
4710MQ \$1459

FANGBOOK EVO HX7-100

Intel® Core™ i7 Processor 4710MQ
Windows 8.1
Intel HM87 Chipset
17.3" Full HD Display 1920x1080
8GB DDR3 1600MHz Memory
1TB SATA300 Hard Drive
Nvidia® GeForce® 970M 4GB Direct X 11 Video Card
8X DVD+-RW Rewritable Drive
10/100/1000 Mbps Network Card
802.11 AC Wireless LAN

HDMI	7.9 Lb.
IEEE 1394	8X±RW
3 x USB 3.0	4in1 Media Reader
2 hours	Built-in

From **\$1459**



Intel® Core™ i7 Processor
Extreme Edition
4940XM \$1890
4910MQ \$1359
4810MQ \$1149
4710MQ \$1029

FANGBOOK III HX6-100

Intel® Core™ i7 Processor 4710MQ
Windows 8.1
Intel HM87 Chipset
15.6" Full HD Display 1920x1080
8GB DDR-3 1600 MEMORY
1TB SATA300 Hard Drive
Nvidia® GeForce® 860M 4GB Direct X 11 Video Card
10/100/1000 Mbps Network Card
802.11 AC Wireless LAN

HDMI	4.9 Lbs.
IEEE 1394	8X±RW
3 x USB 3.0	4in1 Media Reader
2 hours	Built-in

From **\$1029**



CYBERPOWERPC

730 Baldwin Park Blvd., City of Industry, CA 91746

[800 707 0393
www.cyberpowerpc.com]

All Desktop systems come with 3 year Limited Warranty + lifetime toll free techsupport

NVIDIA®, nForce®, GeForce®, SLI™ are trademarks or registered trademarks of NVIDIA Corporation or its subsidiaries in the United States and other countries. CyberPower PCs use genuine Microsoft® Windows® • www.microsoft.com/piracy/howtoread

Work easy, play hard Windows 8

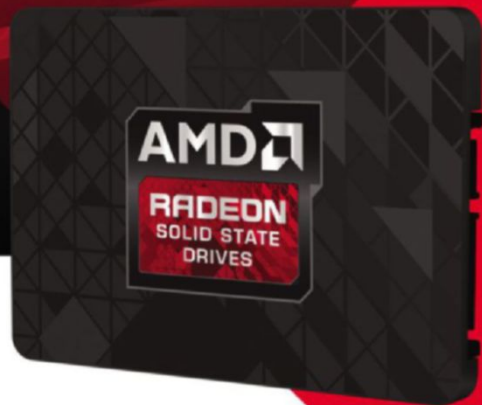


Radeon™ is Gaming

Make the game-changing shift to
Radeon™ R7 Series SSDs.

Prepare yourself for a new level of performance and revel in a storage experience second to none with superior gaming, system responsiveness, and application performance.

See why Radeon is gaming at
www.amd.com/ssd



OCZ SHIELDPLUS WARRANTY

OCZ Barefoot 3 Controller Technology – Delivers the performance and endurance you need for an efficient computing experience

NAND Flash Management – Experience high sustained performance over the long term with the latest A19nm MLC flash from Toshiba

Cloning Software – Enjoy transferring games, programs, and data with ease using Acronis® True Image™ HD cloning software¹

1. Current version of Acronis True Image HD supports Windows XP, Windows Vista, Windows 7, and Windows 8



A Toshiba Group Company

An OCZ Storage Solutions-A Toshiba Company product. AMD brand, technology names and logos used under license from Advanced Micro Devices, Inc. © 2014 Advanced Micro Devices. AMD, the AMD Arrow logo, Radeon, and combinations thereof are trademarks of Advanced Micro Devices, Inc. All rights reserved.

MAXIMUMPC

EDITORIAL

Editor-in-Chief: Tuan Nguyen
Online Managing Editor: Jimmy Thang
Technical Editor: Tom McNamara
Contributing Editors: Alex Castle, Jeremy Laird, Josh Norem
Contributing Writers: Marco Chiappetta, Simon Crisp, Tom Halfhill, Christian Hall, Dave James, Andy Kelly, Paul Lilly, Gordon Mah Ung, Thomas McDonald, Tom Senior, Tyler Wilde, Henry Winchester
Copy Editors: Mary Ricci, Andrew Westbrook
Editor Emeritus: Andrew Sanchez

ART

Group Art Director: Steve Gotobed
Art Editor: Richard Hood
Additional Design: Fraser McDermott
Photographer: Mark Madeo

BUSINESS

Vice President, Sales:
 Stacy Gaines, sgaines@futureus.com
Vice President, Strategic Partnerships:
 Isaac Ugay, iugay@futureus.com
Regional Sales Manager:
 Michael Plump, mplump@futureus.com
Regional Sales Manager:
 Tad Perez, tperez@futureus.com
Regional Sales Manager:
 Austin Park, apark@futureus.com
Regional Sales Manager:
 Jessica Reinert, jreinert@futureus.com
Vice President, Marketing & Sales Development:
 Rhoda Bueno
Newsstand Director:
 Bill Shewey

PRODUCTION

Production Manager: Mark Constance
Production Controller: Ian Wardle
Project Manager: Clare Scott
Production Assistant: Emily Wood

FUTURE US, INC.

4000 Shoreline Court, Suite 400, South San Francisco, CA 94080
 Tel: 650-872-1642, www.futureus.com

Senior Vice President: Charlie Speight
Senior Finance Manager: Wendy Chin
Human Resources Manager: Laura Millard

SUBSCRIBER CUSTOMER SERVICE

Maximum PC Customer Care,
 P.O. Box 51592, Harlan, IA 51593-1352
 Website: www.maximumpc.com/customerservice
 Tel: 800-274-3421
 Email: MAXcustserv@cdsfulfillment.com

BACK ISSUES

Website: www.maximumpc.com/shop
 Tel: 800-865-7240

REPRINTS

Future US, Inc., 4000 Shoreline Court, Suite 400,
 South San Francisco, CA 94080
 Website: www.futureus.com



Future produces carefully targeted magazines, websites, and events for people with a passion. We publish more than 180 magazines, websites, and events and we export or license our publications to 90 countries across the world.

Future plc is a public company quoted on the London Stock Exchange.

www.futureplc.com

Non-executive Chairman: Peter Allen
Chief Executive: Zillah Byng-Maddick
 Tel +44 (0)20 7042 4000 (London)
 Tel +44 (0)1225 442244 (Bath)

©2015 Future US, Inc. All rights reserved. No part of this magazine may be used or reproduced without the written permission of Future US, Inc. (owner). All information provided is, as far as Future (owner) is aware, based on information correct at the time of press. Readers are advised to contact manufacturers and retailers directly with regard to products/services referred to in this magazine. We welcome reader submissions, but cannot promise that they will be published or returned to you. By submitting materials to us you agree to give Future the royalty-free, perpetual, non-exclusive right to publish and reuse your submission in any form in any and all media and to use your name and other information in connection with the submission.



Tuan
Nguyen

PASSION TRUMPS EVERYTHING

ON A RANDOM DAY in late 1996, I was strolling through a shopping mall and passed by a book store. While browsing, a magazine called *boot* caught my eye. It was the premier issue, too—lucky me. Inside was a CD containing tools, game demos, freeware, and anime.

After arriving home that evening, I opened the foil wrapping and started my journey with *boot*. By the time I finished, I was entrenched and captivated. It was filled with attitude, style, and energy. It covered tech and culture. It was cutting-edge stuff and every article was entertaining. I was in love. One day, I promised myself, I would write for *boot*.

Several years later, *boot* was renamed *Maximum PC*. I decided then that I would write to the editor-in-chief and plead for a chance to contribute something. Anything. Despite fully believing that I wouldn't receive an answer, a reply did come. I was given a very generous chance to write a small piece for the mag as a trial. I didn't have any experience writing for print at that time, so there was only a sliver of hope. But it was enough. I didn't even care if I would be paid—it wasn't about the money. I was humbled.

Over the next several issues, my contributions to *Maximum PC* as a freelancer became more frequent. And then one day, I was given the opportunity to write a feature story. I was nervous and excited all at once. Frankly speaking, I thought I was dreaming.

Several weeks later, my article was published: "Motherboard Minutia," a feature on how motherboards are de-

signed, engineered, and produced. I had succeeded in publishing topics about technology, a passionate field for me, in the magazine that I was passionate about—and still am.

Fast forward 18 years. I'm proud to say that this is my first Ed's Note, and it all started on a glimmer of hope. Thank you, Jon Phillips.

My story is two-fold. Dreams do come true and passion trumps everything. As technology has evolved, one constant message has always remained true within these pages: no matter what the hurdles, never give up your passion for the things you love, whether they be customization, building, gaming, or learning about technology.

From the beginning, we've been passionate about one thing: the cutting edge. So here's to the next chapter—you get to ride shotgun.

Tuan Nguyen is Maximum PC's editor-in-chief, also known as "the pointy end of the stick." He's been writing, marketing, and raising hell in the tech industry for 19 years.

submit your questions to: comments@maximumpc.com

THE NEWS

Solid-State Drives Go 3D

Ten terabyte SSDs within two years? Hell, yeah

IS 2015 THE YEAR OF 3D SSDS?

It will certainly see the SSD war hotting up, as Intel and Micron have teamed up against Samsung in the battle of 3D NAND memory and mighty tech empires. The most immediate impact of 3D memory will be a dramatic increase in drive capacities and in turn a major tumble in the bucks-per-gigabyte metric. Solid-state drives should get both bigger and cheaper. Great.

Much like the stacked RAM coming to graphics memory, slabs of the NAND silicon that goes into SSDs is being built up in layers and linked with billions of pillars or connections.

Samsung was first to the punch in late 2014 with its Samsung 850 Pro and 850 EVO, which are just hitting store shelves as we go to press. Its 32-layer NAND comes in MLC densities of 86Gb and TLC

densities of 128Gb per chip. The partnership between Intel and Micron, meanwhile, is set to produce far bigger MLC and TLC densities of 256Gb and 384Gb, respectively. That makes for dies with 32GB and 48GB capacities. The South Korean tech giant isn't going to just let that fly, however. A new generation of Samsung's V-NAND tech is expected in the second half of 2015. We anticipate some seriously high-capacity goodies at its SSD Summit later this year.

Having such high-density NAND modules means companies will be able to produce much higher capacity

SSDs at affordable prices. Intel even expects 10TB SSDs within the next couple of years. When that happens, the current enthusiast paradigm of an SSD as boot and application drive paired with magnetic drives for mass storage may fade away rapidly. We'll be going pure solid state.

The big SSD guys aren't the only ones making the switch, either. Toshiba has started work on moving its 2D NAND fab in Mie, Japan, to 3D NAND production and is expecting to be shipping products in 2016.

All of which means the next 12 months or so is looking a lot more exciting than last year

for SSD tech in general. Sure, we had the first stirrings of the new M.2 and SATA Express interfaces in 2014. But the latter is looking increasingly stillborn. As for the former, it feels very much like the interface of choice for the future. However, we're still waiting for it to deliver on its full promise.

That's because so far we've only seen half of the technical package promised by M.2—the high-bandwidth PCI Express part. What we're still waiting for is the new NVMe control protocol. NVMe is a whole new control interface that's designed from the ground up for SSDs. It replaces the magnetic drive-optimized AHCI protocol and should boost random access performance dramatically.

Put it all together, then, and this year promises to become a perfect storm of SSD technology. Cheaper and yet much more capacious drives will be enabled by 3D memory. Then PCI Express and NVMe will supercharge performance in terms of both peak throughput and random access. So that's better, cheaper, faster. It's the PC doing what it does best, all over again. —DJ & JL



This year promises a perfect storm of SSD technology. Better, cheaper, faster.



Samsung was first to the 3D punch with its 850-series SSDs. Intel, Micron, and Toshiba are hot on its heels.



Yours.

Starting at
\$399

Call Us:
888-462-3899

Customize Online:
ibuypower.com/SBX



SSDs LAST 1,000 YEARS

New tests reveal the staggering endurance of solid-state drives



Kingston's HyperX can soak up enough writes to last a millennium in normal usage.

SOLID-STATE STORAGE drives (SSD) are relative newcomers to the storage scene compared to media like mechanical hard disk drives, so understanding of their long-term reliability is still developing. In the absence of a DeLorean equipped to race back and forth in time, the next best way to test SSDs for longevity is to bombard them 24/7 with reads and writes. It turns out that such a test is taking place with two SSDs having survived 2 petabytes of write tests so far.

The curious folk at TechReport started testing a batch of SSDs a year ago. They kicked off with the Corsair Neutron Series GTX, Intel 335 Series, Kingston HyperX 3K, and Samsung 840 Series. The two left standing are the Kingston and Samsung drives, both of which surpassed 2 petabytes of writes and are still going strong. Most consumer SSDs will process up to a couple of terabytes every few years. So, to write 2 petabytes of data under normal use, you'd be looking at about 1,000 years.

Luck of the draw plays a factor, as TechReport's first HyperX 3K SSD died after reaching 728TB. Nevertheless, that's a lot of data, and like the other four drives that died during the endurance test, it "vastly" exceeded its official specifications. "More importantly, the drives all survived far more writes than most users are likely to generate. Typical consumers shouldn't worry about exceeding the endurance of modern SSDs," TechReport writes.

Granted, this is just one test, but the results are promising. They're also a huge improvement from the early days, when every other bootup felt like Russian roulette. Well, almost. Time, then, to upgrade SSDs from emerging tech to tried, tested, and recommended? Absolutely. **-PL**

INTEL INSIDE GOOGLE GLASS



WILL NEW PARTNERSHIP HELP INTEL FINALLY CONQUER THE MOBILE MARKET?

INTEL WILL BE PAIRING WITH GOOGLE GLASS, replacing Texas Instruments as the supplier of chips that power the wearable device, according to the *Wall Street Journal*. The Santa Clara chip maker is said to be producing processors for a new version of Google Glass that's expected to come out later this year. The *Journal* says Intel plans to actively promote Glass in places such as hospitals, while simultaneously developing new workplace uses for the technology. At present, Glass is largely considered a consumer device.

The move could also help boost the perception of Intel's x86 microprocessor technology, which hasn't caught on in the ultramobile market in the face of strong competition from ARM chips. Following the initial hype, excitement over Glass seems to have waned, though that hasn't stopped Google rolling out improvements. Glass is now compatible with prescription lenses and ships with twice as much RAM as when it first debuted. **-PL**

CYBER CRIMINALS IMPROVE THEIR GRAMMAR

High tech bad guys brush up their low brow language

RESEARCHERS AT PHISHLABS recently stumbled on a fake browser warning being used to distribute Zeus, a well-known favorite for cyber scoundrels attempting to steal banking info. But the use of Zeus is not what caught the analysts' attention—they found the fake warning to be better written than usual.

"Generally speaking, grammar and spelling are often indicators of requests that lead to malware, but cyber criminals have caught on and stepped up their game. Although it is not perfect, the warning observed in this case was much more accurate than what we usually see," said Paul Burbage, a threat analyst at PhishLabs, while warning that clicking on the "Download and Install" results in the user being redirected to a malicious site that downloads the malware. Sounds like the bad guys' ability to string a sentence together has finally caught up with their coding skills. **-PC**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

WINDOWS 8 FTW

It's taken a long time, but Win8 and 8.1 have finally overtaken Windows XP in terms of market share.

FREE DLC

Long-suffering Ubisoft customers were appeased with free downloads for the beautiful but borked *Unity* installment of *Assassin's Creed*.

GOOGLE'S FAST FIBER

Google continues to roll out its insanely fast 1,000Mb/s fiber Internet service. Austin, Texas, is the latest beneficiary, for just \$70 a month.

TRAGEDIES

RIP CLIP ART

Microsoft's Clip Art library has been EOL'ed. Instead, the Beast of Redmond wants us all to use Bing's online image search. Adios.

IPAD SALES SLIP

Turns out tablet owners don't switch up devices like smartphone lovers. Most people who want an iPad already have one.

SONY VS. NORTH KOREA

Was North Korea behind the cyber-attack on Sony Pictures? Wouldn't make a bad movie...



Tom Halfhill

FAST FORWARD

Tiny Processors for the Internet of Things

LAST MONTH I DESCRIBED two of the world's most powerful microprocessors. But chip makers aren't always thinking big. Some of the most surprising new designs are in the smallest processors—particularly for wearable devices and the Internet of Things (IoT).

Smart watches and Google Glass are only the first examples of wearables. Expect many more, including physical implants. IoT devices include everything from smart thermostats and smoke alarms to industrial machinery and car navigation systems. Processors for these gadgets share three requirements: they must be small, consume very little power, and provide wireless connectivity.

The obvious solution would seem to be microcontrollers, which have been around for decades. On a single chip, MCUs integrate a CPU core, SRAM, nonvolatile memory (usually flash), and peripherals. Those peripherals typically include counters, timers, analog/digital converters, and digital/analog converters. Some even have USB or Ethernet controllers. Essentially, an MCU is a single-chip computer that can function without external DRAM.

But MCUs lack one crucial feature—wireless connectivity. For that, they need external radio chips. And those additional chips consume more power and board space, which are scarce resources in wearables and IoT devices. Although some early gadgets use conventional MCUs, we need new processors that add wireless to their bag of tricks.



Processors for these wearable gadgets and IoT devices all share three requirements: they must be small, consume very little power, and provide wireless connectivity.

They're coming. One example is Marvell's new 88M processor family. The fastest chip has a 200MHz ARM Cortex-M4F core. With 512KB of SRAM, it doesn't need external DRAM to run a small OS and simple software. More important, this chip has an 802.11n Wi-Fi radio. Two similar models add flash memory and replace the Wi-Fi with either a Bluetooth or Zigbee transceiver. Designers can build a working system by adding only an external crystal and antenna. Total cost for this combo: about \$10.

Marvell's tiny processor sips mere milliwatts of power, but it's still not small enough for some things. That's why French firm Cortus recently introduced a 32-bit CPU core with an abbreviated three-stage instruction pipeline. By contrast, Intel's Haswell processors have up to 19 stages. The Cortus APS23 is about the same size as ARM's smallest core, the Cortex-M0+, which has a two-stage pipeline.

To beat that, a Slovenian company recently astonished a Silicon Valley conference by announcing a CPU core that has no pipeline at all. (This is like showing up at an automotive industry conference with a one-cylinder push-valve engine.) Beyond Semiconductor's new BA20 is almost a throwback to the '70s, except it's a real 32-bit processor. Stanford Univer-



On-chip radios should solve bad battery life in wearables.

sity, meanwhile, has prototyped an ant-sized processor that uses so little power it harvests what it needs by absorbing radio waves.

Another challenge is shrinking the transceivers and antennas. An IoT processor may need radios for Wi-Fi, cellular, Bluetooth, Zigbee, GPS, or near-field communications (NFC). Some of those require multiple radios—Wi-Fi operates in the 2.4GHz and 5GHz bands, while cellular networks use many different frequencies. This challenge is more difficult than making tiny CPU cores because analog circuitry doesn't shrink as neatly.

Nevertheless, the race is on to build smaller, cheaper, more power-efficient IoT processors. Before they mature, we'll have to tolerate inconveniences, such as bulky smart watches that require daily charging. But remember, the first cell phones were as large as World War II walkie-talkies.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

MASSIVE POWER INSIDE AN INCREDIBLY SLIM DESIGN.



"ONE OF THE **FASTEST** AND ONE OF THE **QUIETEST** MICRO TOWERS" - Maximum PC

"IT PACKS A **WHOLE LOT OF POWER** INTO AN ITTY-BITTY BOX" - PC Gamer

DIGITAL STORM BOLT II

BUY NOW: WWW.DIGITALSTORM.COM



ACCREDITED
BUSINESS





Thomas L. McDonald

GAME THEORY

Disunity

ASSASSIN'S CREED UNITY IS EVERYTHING big and dumb and glorious and awful in gaming. A titanic 50GB download on Steam that did everything but kick me in the groin, *Unity* nonetheless has the kind of hugeness that impresses by the sheer force of its size and ambition.

And I've already deleted it.

Here's a brief summary of things I need to do to play *Unity*: Two days to download it on Steam, since I'm using my computer for other tasks and did I mention the 50GB download? Hit play. Wait. Watch the Uplay menu load on top of the Steam menu. Why? Beats me. None of the features offered by Uplay are all that great or need their own shell. It's just bloatware that places monetization over user experience.

Wait. "This game was made by a..." Oh, shut the hell up about it already. Take note of menu screen, obviously designed for consoles and not PCs.

Click on Initiates button. See a QR code because Ubisoft thinks it's 2007 and QR codes are cool and useful rather than being Satan's Fingerprint. The QR code directs me to a 395MB (!) iOS app called *Assassin's Creed Unity Companion* (current rating: 1 star) required to unlock in-game content.

Wait for app to load. Attempt to get Initiates to function, a comical process involving password resets, account linking, and bad app gaming. Slog through it all with images of blue chests dancing in my head, only to learn that I have to be playing the grindingly awful app while I'm playing the game itself. Check online to see how all this works only to learn the app may well screw up my save games.

Delete app, give up on blue chests, and simply try the first mission. Gaze in awe at the sumptuously

rendered cutscene for about three seconds before the image freezes and the audio continues to play.

Wait. Knock graphics detail down to medium. Restart. Experience the cutscene with slightly fewer skips. Get to the game itself. Watch as it freezes every few seconds. Thrill to the pop in. Gaze in awe at the draw-times.

Knock graphics detail down to low. Start over. Decide that, although I haven't played more than 15 seconds of the game, I should check out the offerings in the store. Note that in-game currency is offered in bundles ranging from \$5 to \$100, even though, according to various reports, there is not \$100 worth of merchandise to buy.

Finally get down to business, and experience about 20 minutes of good *Assassin's Creed* gameplay until the first show-stopping crash forces a

cold reboot. Struggle through more crashes, a little bit of decent gameplay, no blue chests, various glitches, and finally give up and return to *Crusader Kings II*.

Unity is a perfect study in how big-budget games can go wrong thanks to monetization, loyalty programs, app integration, and simply shipping unfinished product. They've added obstructions and cost without any benefit to the consumer whatsoever. Publishers have long been searching for that line where aggressive monetization becomes so obnoxious that the consumer rebels. With *Unity*, they finally found it.

Thomas L. McDonald is editor-at-large of *Games Magazine*.



Unity is a textbook case of how big-budget games can get it big-time wrong.



See a QR code because Ubisoft thinks it's 2007 and QR codes are cool rather than being Satan's Fingerprint. The QR code directs me to an app called *Unity Companion* (rating: 1 star).

THE LIST

8 FREE HARDWARE-MONITORING TOOLS

8

CPU-Z:

Get a read out of your CPU's clock speed, multiplier, and BUS speed.



7

GPU-Z:

Provides detailed specs of your GPU's clock speeds and memory size.



6

FURMARK:

This program will indicate if your GPU overlocks are running too hot.



5

FRAPS:

Provides a real-time frame counter and frame rate log during gameplay sessions.



4

PRIME 95:

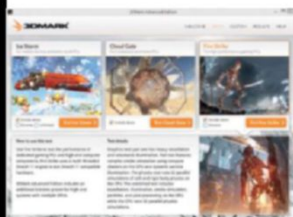
A stress test for your CPU. You can use this to see if your CPU clocks are stable.



3

3DMARK:

See how your graphics stack up against others with a 3DMark score.



2

AMD CATALYST CONTROL CENTER:

Monitor and change AMD cards' core and memory clock speeds.



1

EVGA PRECISION X:

Monitor and overclock your Nvidia GPU clock speeds.



ENERMAX



Thermamax GIANT



TALKING

Farewell to a Legend

After 16 years, it's time to say goodbye to Gordon

To celebrate, commemorate, maybe even commiserate the departure of long-term *Maximum PC* staffer, all-time hardware expert, and part-time muckraker Gordon Mah Ung, here are some highlights from his very last podcast. Gordon's rants, preachings, and polemics have been a highlight for *Maximum PC* parishioners for over a decade and a half. And this final podcast is no exception. His soaring oratory and low expletives lay waste to mainstream media assumptions, Han Solo's hero status, poor old console graphics, and, yes, Apple's bent iPhones. Adieu, Gordo. Adieu.



Gordon warms up for one last rant as *MPC* editor-in-chief.



Head to www.maximumpc.com for the full, unabridged podcast.

MPC:

Tell us about the huge changes to the PC you saw over your 16 years on *Maximum PC*.

Gordon:

There's an old YouTube clip from 2001 from a TV show *PC Chronicles*. I was on it though I can't even remember being there. Anyway, we look back now and laugh at the Alienware rig on that show. It's just a painted case. But that was groundbreaking, people were like "holy s***!"

MPC:

It looks like something we might have thrown together at home...

Gordon:

Back then it was a different world. Alienware blew everyone away with the paint jobs. Then Voodoo stepped up with their super braided cables. It was just Alienware, Voodoo, and Falcon back then. It's just amazing what computers looked like, all those wide parallel ATA cables.

MPC:

So, what do you think has been the biggest issue concerning PCs over your years?

Gordon:

Over the whole 16 years, every year the f***ing mainstream media said PCs were dead. Well, frankly, gaming PCs have never been stronger. That is amazing when you think about it. Every year you hear, "yeah, it's over." But here we are.

MPC:

Why is that?

Gordon:

Because technology doesn't stand still. That Alienware box on *PC Chronicles* was probably a Pentium 4 with a GeForce 2 card in it. My phone is more powerful than that. It's never going to stop. We're not going to suddenly stop at 1080p or 4K or 40 megapixels. Nvidia, AMD, and Intel aren't going to stop making faster chips.

TECH



Explaining why Han Solo was basically a drug-running terrorist.

The latest data is that the growth is in desktops. iPad sales are significantly down, laptops are down, too. The only shiny spot is desktops.

Then there's the thing where people think one day my phone will be my computer. I'll come home, it'll automatically turn on my monitor and keyboard and pick up exactly where I was at work. But it's simple physics. Can you ever get out of a phone what you can get out of a desktop machine with four video cards and a 1,200W power supply? Forget it.

MPC:

Yeah, there's the replacement value issue, too. If you have a Nexus 7, do you need a Nexus 9? It's just a consumption device and it works fine. Anyway, any final MPC rants you want to get off your chest?

Gordon:

Here's one thing I want to know. What did the *Star Wars* Storm

Trooper armor do? Nothing. First, why is it f***ing white, don't you stand out in white as a target? Also, it didn't work against blaster fire or even arrows and rocks from the Ewoks. It's not armor. Don't call it armor if it's not actually armor.

Here's another thing. Do we *really* know if Han Solo dumped that spice? Jabba was paying him to make a delivery. Han says he had to dump the spice. But he's just a drug runner. He probably stole that spice and sold it. Han Solo didn't dump it, he sold it on the black market. This supports everything I've been saying—the Empire has not been evil this whole time. The Rebels overthrew a legitimately elected government.

MPC:

But the Empire did blow up planets, Gordon.

Gordon:

We don't even know that, we just saw the *Star Wars* documentary

Gordon on Giving...

... some antialiasing back to the deprived console community

"So, I was at Toys R Us and my son is playing on the Xbox One. Yeah, yeah, it's better that he's playing on Xbox than playing with all the Nerf gun stuff that I'm not gonna buy (it's called Amazon!). He's playing *Forza*, and the aliasing was like huge jagged stair steps, it was like playing with LEGO. So, we should pass the hat around the PC community and give them some of our antialiasing, they could really use it. We have way too much, I don't need 18x AA, what the hell do I need that for, I'm running 4K? We've got an excessive amount of AA. We should stop hoarding AA on the PC and share some of that with the consoles."



Should PC users share their antialiasing riches with Xbox owners?

that was biased because it was made from the Rebel point of view. History is written by the victors. It all adds up. You've got a drug runner, mercenary, and murderer running around destroying government property.

And while we're talking sci-fi, all these companies are spending hundreds of millions of dollars on developing smartphones. Why can't they just make a bluetooth communicator like a *Star Trek* communicator, just a speakerphone with a big-ass battery. It would hook up to your phone by bluetooth and work like a communicator. You could sell millions of these things.

MPC:

OK... so, how about those bent iPhones? We're thinking you've given that a little thought...

Gordon:

Jimmy [Thang] said he thinks the whole bent iPhone thing is overblown. Apple said, no, no, no, not a problem, there's only been nine reports out of billions of iPhone 6 Plus' that have been bending. And people say the original iPhone bending video was faked. But then oneofthenine.com have hundreds of bent iPhones. And there's this great example of a guy who asked his friend if his phone was bent and the guy is like, "no way," but they take it out and it turns out it's f***ing bent, only slightly, but still bent. This is a massive screw up.

MPC:

That's a wrap. An Apple rant to end, entirely appropriate. And an instant classic. 🎮

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

- > VGA Cooling
- > GPU Upgrades
- > Sluggish PCs

Busted Frozr

Doc, I've got an aging Nvidia GTX 570 card from MSI that came with a Twin Frozr II cooler. While considering the possibility of either an upgrade or SLI configuration, I noticed the temperatures on my GPU were getting very high according to the monitoring software I use, especially under load. After investigating, I discovered one of the fans on my card had completely seized up while the other stuttered and barely ran at all. I've since removed and cleaned the card, disassembled the Twin Frozr II assembly to gain access to the fans' rear area in an attempt to perform a lube, and reinstalled everything. After all that I discovered I'd completely failed to coax either fan back to life.

I now have a quasi-serviceable video card that lacks a working cooler (I found one option to buy a replacement fan bundle, but it's sourced in China and comes with hefty import fees). As things stand, anything more taxing than short streaming videos pushes temps up to and beyond 90 C. My rig has been hobbled, and I don't like it. I'm now seeing phantom longevity issues with heat-sink/fan combination coolers wherever I look. I'm needing some reassurances that if I buy a new card today, I won't end

up in the same situation a few years down the road. Also, an explanation as to why no one seems to offer an off-the-shelf water cooling solution for GPUs would be good.

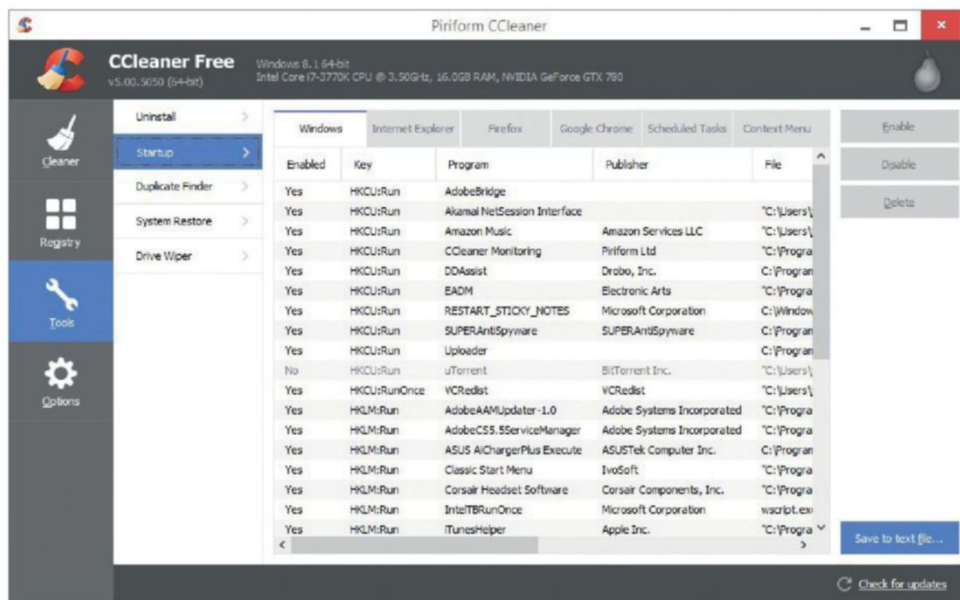
—Brandon Kalaskie

THE DOCTOR RESPONDS: Our main advice is to examine the manufacturer's warranty before purchase. For video cards, warranties typically range from three to five years, which should be sufficient

given how fast technology advances, but we realize some people aren't always able to upgrade. If your product fails once it's past that warranty period, well, there's not much you can do. Many of us actually look forward to such a failure, as it gives us a spouse-proof excuse to upgrade.

For your case, there are aftermarket solutions both in the air and water realms. For air coolers there are a ton of options that fall under the

Google phrase "VGA cooling." Arctic Cooling is the most prolific, as it's been making add-on coolers for GPUs for as long as we can remember. The primary consideration for these coolers is to make sure they're able to cool the onboard components and memory of the card, as they can get just as hot as the GPU at full load. Most coolers have heatsinks you can apply to the memory modules and an airflow pattern that washes over the rest of



In addition to removing unwanted files from your PC, the excellent and free CCleaner also has a powerful Startup examination utility.

submit your questions to: doctor@maximumpc.com

the components, but make sure you're not ignoring the overall board temps in favor of just monitoring your GPU temp. Also, our Google Fu shows us the Zalman VF3000 is specifically designed for your GTX 570 card, and there are a few of them for sale on eBay.

On the liquid cooling front you have a few options. First NXZT makes a GPU cooling system called the Kraken G10 that's compatible with the GTX 570 and costs \$30. You still need to bring your own closed-loop liquid cooler (CLC), but it'll work with a variety listed on the product page: <http://bit.ly/krakeng10>. Its thermal coverage isn't as good as a block designed for custom liquid cooling, but going that route would cost as much as simply replacing the card. You'll need a fan mount inside your case for the G10's CLC, too, so make sure your case can accommodate this. Corsair has also announced a liquid cooling solution for GPUs named the HG10. It also requires you purchase a separate Hydro Series liquid CPU cooler, just like with the NZXT. Sadly the Corsair cooler is vaporware at this point, and we've no idea when it will appear on the retail horizon.

SLI Gone Bad

I have a Dell XPS 730 that had dual Nvidia GeForce 9800GT cards in SLI Mode. A week ago my screen went haywire so I removed one card at a time and found one to be the culprit. I had great performance with both cards in SLI mode. Now that I have just one card, performance is much worse. Since I don't have a whole lot of money to spend (maybe up to the mid-to-upper \$300 range), what would be a good replacement card(s) that meet or exceed the dual 9800GT SLI performance?

—Robert Orsino

THE DOCTOR RESPONDS:

According to an exhaustive Google scouring, the Dell XPS 730 uses an ancient Intel Core 2 Quad CPU. While we could recommend a decent video card

in the \$250-\$300 range, it'll be bottlenecked by that sluggish CPU. It's always important to match your CPU's overall power with your GPU's. Given your CPU's level, we think you'll get better value out of a midrange GPU such as the AMD Radeon R9 285 or the Nvidia GeForce GTX 760.

Super Slow

Hey doc, I hope you can give me some direction on this. So, my parents bought a new Dell PC about four years ago. It's running Windows 7, has 6GB of RAM, a 1TB HDD, a graphics card (not sure which one), and most of all an AMD Phenom X6 CPU at 3GHz. It was a great deal when my dad found it, and for what they do, I thought it would be perfect! I thought the Phenom X6 would be blazing fast. My mom mostly surfs the net and does some light picture editing.

Well, a little while after they got it, my mom complained about how slow it seemed, so I went over there one weekend and attempted to use their PC. It took over five minutes to see the start of the desktop and another five minutes before I could click on anything. Then Internet Explorer kept freezing on me. The HDD is only 15 percent full, so I know a full HDD isn't the problem. I bet there is some bloatware that could be removed, but it just seems SO slow that there has to be something else going on. Any recommendations on where to start? Do you think maybe the HDD is just that slow? I mentioned an SSD to them and reinstalling the OS, but they're not sure they want to do that unless it's the only way. Any help would be wonderful.

—Jarod Myrick

THE DOCTOR RESPONDS: First off Jarod, we're positive many people reading this are feeling PTSD symptoms from having to fix a slow PC for relatives. It's probably the most common ailment for your garden variety rig out there in the wild, and

back when The Doc was a PC repair technician it was the number one problem we had to deal with—PCs full of bloatware, viruses, toolbars, antivirus programs, and worse. Seeing those PCs in such a sorry state always broke our hearts. The good news is we have some baseline tactics.

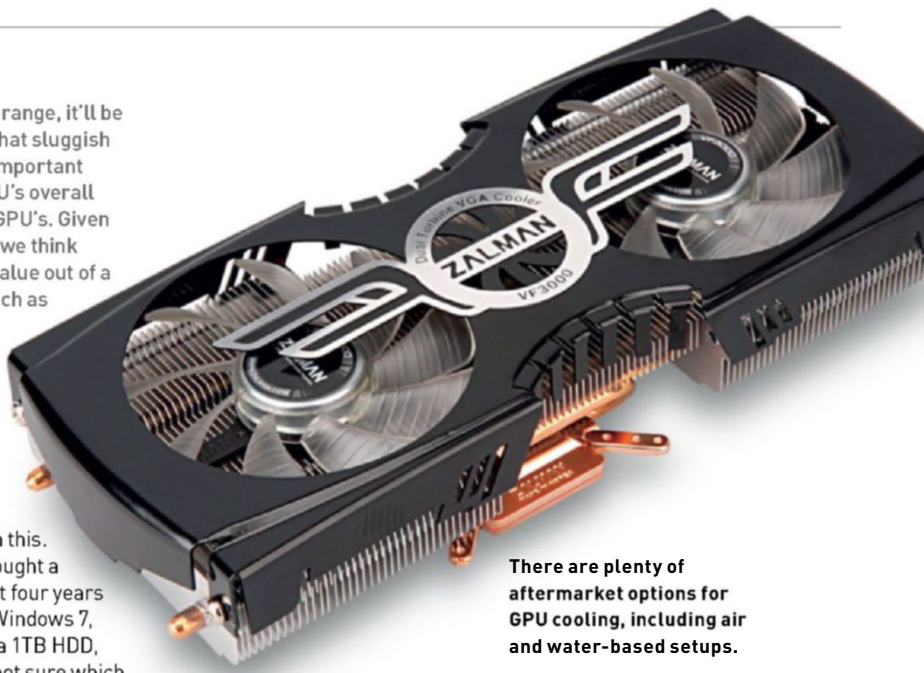
First, comb through the Programs and Features menu in the Control Panel and remove any program not being used. Sometimes Malware likes to hide in plain sight. Next take a look at what's starting automatically by typing "msconfig" into the search box in the Windows Start menu. This will display services and programs that start automatically every time your PC boots. You'll want to check the box labeled "Hide all Microsoft services" before purging, but once those are cleared just examine the list and use your judgement. You probably need your antivirus or fan control service to start automatically, but not an app that checks for updates on a piece of software you give zero effs about. When it comes to the Startup tab, this is where you'll see a real difference in boot times and overall readiness after boot. Be careful here, but keep in mind that whatever you uncheck can always be rechecked if a problem arises.

There are plenty of aftermarket options for GPU cooling, including air and water-based setups.

We also recommend downloading and installing the excellent free utility CCleaner, as it can quickly and easily remove excess files. As a bonus it also has a built-in Startup utility that is much more extensive than the one included with Windows. It can be found under the Tools menu.

With those basics out of the way, we gotta say your parents' PC sounds like it has an old skool virus or malware infestation. We recommend starting off with Malwarebytes, which is free and great at ferreting out malware. Next scan with SuperAntiSpyware, which is also free and generally excellent. For a virus scan, instead of going to the store [virtual or brick], just run a browser-based scan like the one available from Bitdefender. It's free, fast, and can help.

If you do all of the above you should see an improvement. For boot times, we would normally expect a Windows 7-based "mom and dad" rig to boot in about a minute with an HDD running the show. Installing an SSD could drop that to 30 seconds or so, but not even an SSD can overcome a total system infestation. Our advice is to clean the system, then install an SSD to help keep the system running at breakneck speed so you don't have to go over there anymore. ⏻



SETTING A **HIGHER** STANDARD

ALL GENESIS AND MILLENNIUM FEATURE

Variable Mounting



Standard



90°



Inverted



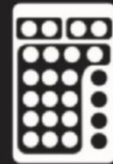
90° Inverted



Professionally
Sleeved Cables



FROSTBYTE
Liquid-Cooling



Built-In
LED Lighting

INCLUDED IN ALL SYSTEMS

Over 10,000
Custom Options

Name-Brand
Components Only

FREE Lifetime 24/7 Service & Support

“Record-setting benchmark performance”
-Maximum PC



ORIGIN PC Elite Gaming Peripherals



Powered by Razer

Award Winning

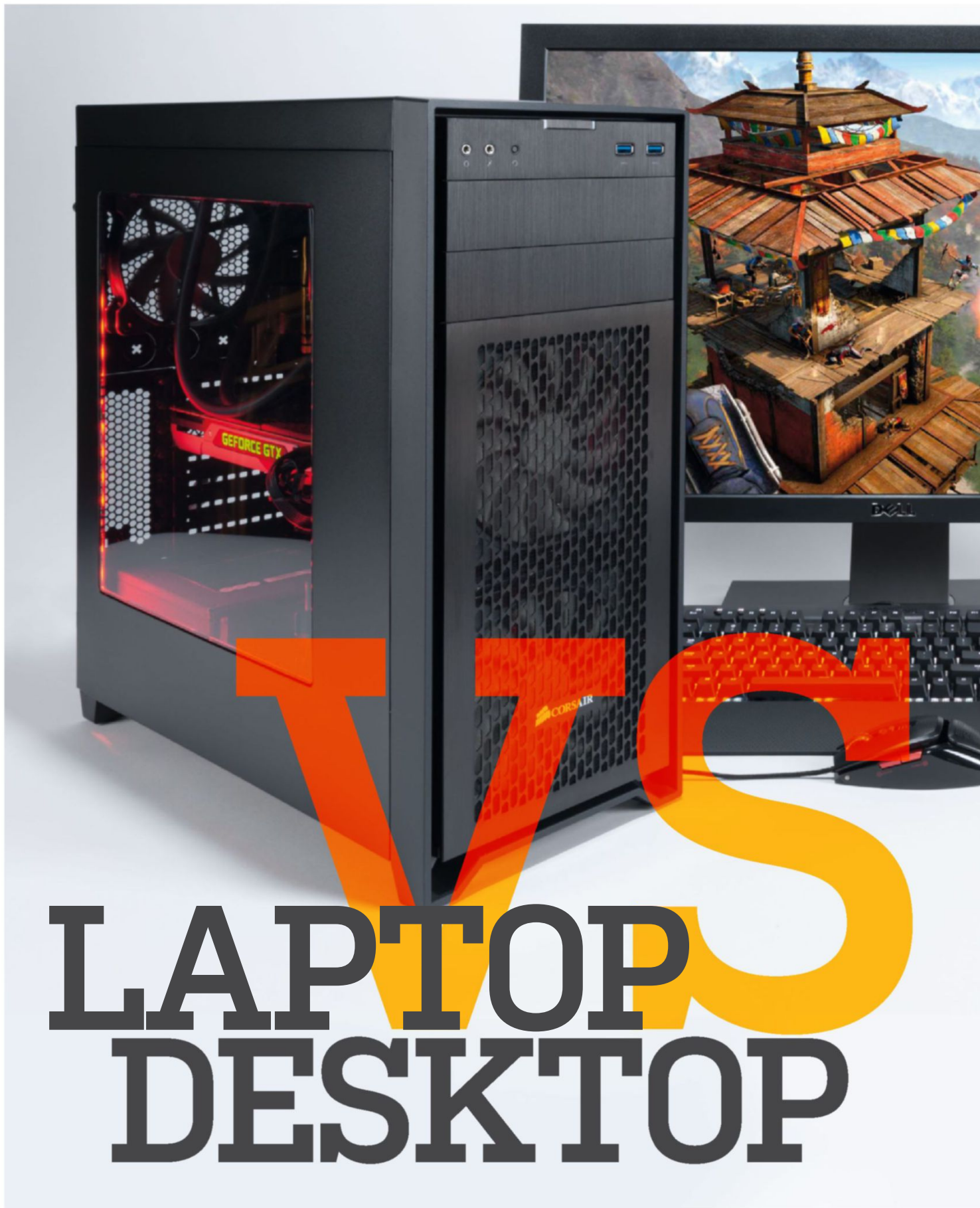


Customize Your Power
ORIGINPC.COM
Online Financing Available!



Follow us @







Gaming laptops have come a long way, but can they really replace desktop rigs?

BY JIMMY THANG



For a long time, many PC gamers scoffed at the idea of gaming laptops. After all, how could you fit all that power in such a small form factor?

And even if you could somehow squeeze it in, it's got to be deafeningly loud or incredibly heavy, right?

Well, the gaming notebook sector is advancing, and it's doing so by leaps and bounds. So much so that big gray box companies are taking notice. HP, for instance, is jumping back in with its Omen gaming notebook.

Gone are the days when a modestly powerful gaming laptop had to be a back-breaker. Many aren't much thicker than some of

the sleek Ultrabooks out there now. But what of performance? The gap between desktop and mobile GPU performance is narrowing faster than a teen's teeth with braces.

So can a desktop-replacement laptop now truly live up to its name? There's only one way to find out, and that's by throwing them both into the Thunderdome. Let battle commence!



CHOOSE YOUR WEAPON

CHOOSE WISELY AT
SAGERNOTEBOOK.COM

Sager recommends Windows.

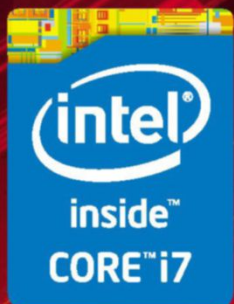
NP

9377-S

- 4th Generation Intel® Core™ i7-4710MQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 17.3" Full HD LED Display (1920x1080) with Matte Finished Screen
- 30 days No Dead Pixel Guaranteed Insurance
- 8GB DDR5 NVIDIA® GeForce™ GTX 980M GPU
- Optional Dual NVIDIA® GeForce™ GTX 970M / 980M GPU with SLI™ Technology
- 16GB Dual Channel DDR3-1600MHz Memory
- 120GB Crucial M500 mSATA III SSD
- 1TB 7200RPM SATA II Hard Drive
- 6X Blu-ray Reader / 8X DVD±R/2.4X +DL Super Multi Drive
- 2 Hard Drives + 2 mSATA SSD Drives Capable with Raid 0, 1 Function
- Full sized Keyboard with LED backlight
- Intel® Dual Band Wireless-AC 7260 Wireless LAN + Bluetooth Wireless Combo
- Built-in Card Reader, Fingerprint Reader and Dual Camera 5.0M / 2.0M HD Video Cam
- Thunderbolt Port & HDMI 1.4 output Port
- Built-in Onkyo speakers and a sub-woofer
- Sound Blaster® X-Fi™ MB3 Sound System
- Microsoft® Office 2013 Trial*

\$2199

AFTER \$150 INSTANT SAVINGS!



Dealer/VAR, Government and Corporate pricing are available. Please call for details.

Sager One Year Limited Warranty Policy: 30-Day Money-Back Guarantee. If the equipment does not work as promised, or if you are not fully satisfied, we will issue a full refund upon the return of all original equipment. 1-Year Parts and Labor Limited Warranty, Lifetime Toll-Free Technical Support. Sager One Year Limited Warranty and Three Year Limited Warranty Policy Applies to End Users in the United States of America. Extended Warranty Available: Check out this comprehensive package of service support. Business Leasing Available: Get your dream notebook with low monthly payment! Sager Corporate Offices: 18005 Cortney Court, City of Industry, California 91748 Tel: 626.964.8892, Fax: 626.964.2381 Hours: Monday-Friday 7:30a.m. - 6p.m. (PST) American Express, VISA, MasterCard & Discover Credit Cards Accepted - No Surcharge. Cashiers Checks Welcome. ©2014 by Midern Corporation, Inc. All rights reserved. Ultrabook, Celeron, Celeron Inside, Core Inside, Intel, Intel Atom, Intel Atom Inside, Intel Core, Intel Inside, Intel Inside Logo, Intel vPro, Itanium, Itanium Inside, Pentium, Pentium Inside, vPro Inside, Xeon, Xeon Phi, and Xeon Inside are trademarks of Intel Corporation in the U.S. and/or other countries. This PC is preloaded with trial version of Microsoft Office 2013. Purchase an Office 2013 Product Key to activate full version Office software. All company and/or product names mentioned herein are trademarks and/or registered trademarks of their respective companies. Prices and specifications are subject to change without notice. Opened software and shipping charges are non-refundable. 30-Day money back guarantee does not include freight or shipping and handling charge.

Call us toll-free at:
800.669.1624

For up-to-the-minute pricing and ordering information:
sagernotebook.com



NP 8652

- 4th Generation Intel® Core™ i7-4710HQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 15.6" QHD LED Display (3840x2160) in Super Clear Glare Type Screen
- 4GB DDR5 NVIDIA® GeForce™ GTX 980M GPU with Optimus™ Technology
- 8GB Dual Channel DDR3-1600MHz Memory
- 750GB 7200RPM SATA II Hard Drive
- 2 Hard Drives + 2 M.2 SATA SSD Drives Capable with Raid 0, 1 Function
- Full sized Keyboard with LED backlight
- Integrated Wireless LAN 802.11b/g/n + Bluetooth Wireless Combo
- Built-in Card Reader and 2.0M FHD Video Camera
- Built-in Onkyo speakers
- Sound Blaster® X-Fi™ MB3 Sound System
- Slim design with only 28.8mm/1.13 inch thin
- Microsoft® Office 2013 Trial*

\$1799



NP 8278-S

- 4th Generation Intel® Core™ i7-4710MQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 17.3" Full HD LED Display (1920x1080) with Matte Finished Screen
- 30 days No Dead Pixel Guaranteed Insurance
- 6GB DDR5 NVIDIA® GeForce™ GTX 970M GPU with Optimus™ Technology
- Optional NVIDIA® GeForce™ GTX 980M GPU
- 8GB Dual Channel DDR3-1600MHz Memory
- 120GB Crucial M500 mSATA III SSD
- 1TB 7200RPM SATA II Hard Drive
- 6X Blu-ray Reader / 8X DVD±R/2.4X +DL Super Multi Drive
- 2 Hard Drives + 2 mSATA SSD Drives Capable with Raid 0, 1 Function
- Full sized Keyboard with LED backlight
- Intel® Dual Band Wireless-AC 7260 Wireless LAN + Bluetooth Wireless Combo
- Built-in Card Reader, Fingerprint Reader and 2.0M FHD Video Camera
- Built-in Onkyo speakers with a sub-woofer
- Sound Blaster® X-Fi™ MB3 Sound System
- Microsoft® Office 2013 Trial*

\$1599

AFTER \$160 INSTANT SAVINGS!



NP 8268-S

- 4th Generation Intel® Core™ i7-4710MQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 15.6" Full HD LED Display (1920x1080) with Matte Finished Screen
- 30 days No Dead Pixel Guaranteed Insurance
- 6GB DDR5 NVIDIA® GeForce™ GTX 970M GPU with Optimus™ Technology
- Optional NVIDIA® GeForce™ GTX 980M GPU
- 8GB Dual Channel DDR3-1600MHz Memory
- 120GB Crucial M500 mSATA III SSD
- 750GB 7200RPM SATA II Hard Drive
- 8X DVD±R/RW/4X +DL Super Multi Drive
- One Hard Drive + 2 mSATA SSD Drives Capable with Raid 0,1 Function
- Full sized Keyboard with LED backlight
- Intel® Dual Band Wireless-AC 7260 Wireless LAN + Bluetooth Wireless Combo
- Built-in Card Reader, Fingerprint Reader and 2.0M FHD Video Camera
- Built-in Onkyo speakers and a sub-woofer
- Microsoft® Office 2013 Trial*

\$1499

AFTER \$175 INSTANT SAVINGS!



NP 8651

- 4th Generation Intel® Core™ i7-4710HQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 15.6" Full HD LED Display (1920x1080) with Matte Finished Screen
- Optional 15.6" QHD LED Display (3840x2160)
- 3GB DDR5 NVIDIA® GeForce™ GTX 970M GPU with Optimus™ Technology
- 8GB Dual Channel DDR3-1600MHz Memory
- 1TB 7200RPM SATA II Hard Drive
- 2 Hard Drives + 2 M.2 SATA SSD Drives Capable with Raid 0, 1 Function
- Full sized Keyboard with LED backlight
- Intel® Dual Band Wireless-AC 7260 Wireless LAN + Bluetooth Wireless Combo
- Built-in Card Reader and 2.0M FHD Video Camera
- Built-in Onkyo speakers
- Sound Blaster® X-Fi™ MB3 Sound System
- Slim design with only 25mm / 0.98 inch thin
- Microsoft® Office 2013 Trial*

\$1399



NP 8268

- 4th Generation Intel® Core™ i7-4710MQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 15.6" Full HD LED Display (1920x1080) with Matte Finished Screen
- 3GB DDR5 NVIDIA® GeForce™ GTX 870M GPU with Optimus™ Technology
- 8GB Dual Channel DDR3-1600MHz Memory
- 1TB 7200RPM SATA II Hard Drive
- 8X DVD±R/RW/4X +DL Super Multi Drive
- One Hard Drive + 2 mSATA SSD Drives Capable with Raid 0, 1 Function
- Full sized Keyboard with LED backlight
- Integrated Wireless LAN 802.11b/g/n + Bluetooth Wireless Combo
- Built-in Card Reader, Fingerprint Reader and 2.0M FHD Video Camera
- Built-in Onkyo speakers with a sub-woofer
- Microsoft® Office 2013 Trial*

\$1299



NP 7338

- 4th Generation Intel® Core™ i7-4710MQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 13.3" Full HD LED Display (1920x1080) with Wide Viewing Angle in Matte Finished Screen
- 2GB DDR5 NVIDIA® GeForce™ GTX 860M GPU with Optimus™ Technology
- 8GB Dual Channel DDR3-1600MHz Memory
- 120GB Crucial M500 mSATA III SSD
- 750GB 7200RPM SATA II Hard Drive
- 1 Hard Drive and 2 mSATA SSD Drives with Raid 1, 0 Function Capable
- Isolated Keyboard with LED backlight
- Integrated Wireless LAN 802.11b/g/n + Bluetooth Wireless Combo
- Built-in Card Reader and 2.0M HD Video Cam
- Sound Blaster™ Cinema Sound System
- Microsoft® Office 2013 Trial*

\$1199



NP 7358

- 4th Generation Intel® Core™ i7-4710MQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 15.6" Full HD LED Display (1920x1080) with Matte Finished Screen
- Also available in 17.3" Full HD LED Display with model NP7378 (without Fingerprint Reader and Backlight Keyboard)
- 2GB DDR5 NVIDIA® GeForce™ GTX 860M GPU with Optimus™ Technology
- 8GB Dual Channel DDR3-1600MHz Memory
- 1TB 7200RPM SATA II Hard Drive
- 8X DVD±R/RW/4X +DL Super Multi Drive
- 2 Hard Drives with Raid 1, 0 Function + 1 mSATA SSD Drive Capable
- Isolated Keyboard with LED Backlight
- Integrated Wireless LAN 802.11b/g/n + Bluetooth Wireless Combo
- Sound Blaster™ Cinema Sound System
- Microsoft® Office 2013 Trial*

\$1099



NP 6658

- 4th Generation Intel® Core™ i7-4710MQ Processor (6MB L3 Cache, 2.50GHz)
- Windows® 8.1 64-bit Edition
- 15.6" Full HD LED Display (1920x1080) in Super Clear Glare Type Screen
- Also available in 17.3" Full HD LED Display with model NP6678 (with Backlight Keyboard)
- 2GB DDR3 NVIDIA® GeForce™ GT 850M GPU with Optimus™ Technology
- 8GB Dual Channel DDR3-1600MHz Memory
- 750GB 7200RPM SATA II Hard Drive
- 8X DVD±R/RW/4X +DL Super Multi Drive
- 1 Hard Drive + 1 mSATA SSD Drive Capable
- Integrated Wireless LAN 802.11b/g/n + Bluetooth Wireless Combo
- Built-in Card Reader and 2.0M HD Video Camera
- Sound Blaster™ Cinema Sound System
- Microsoft® Office 2013 Trial*

\$999

SLUGGING IT OUT

Who's your money on? The heavyweight champ or the light-footed contender? Desktops and gaming laptops go eight rounds to see which is best

GPU

Let's face facts. As powerful as gaming laptop GPUs have become, they will always be slower than their desktop counterparts. You can always cram more power into larger components; it's simple physics. But gaming laptop GPUs are narrowing the divide, and this has been the case with every passing generation of mobile GPUs. According to Nvidia, its Fermi-based 480M GPU only offered 40 percent of the performance of its 480 desktop equivalent back in 2010. Nvidia claims the gap narrowed to 60 percent with the Kepler-based 680M. Now Nvidia says the 980M is roughly 70–80 percent as fast as its current flagship GTX 980. From our internal testing (which you'll read more about on page 33), our numbers don't support those figures across the board, but they aren't terribly far off.

But performance issues aside, a glancing blow to mobile GPUs is that you can't typically swap them out. The beauty of gaming on a desktop PC is that if a beefier card comes along, you can just pop it in. In addition, while there are some dual-GPU options in the gaming notebook space, they are few and far between. And four-way mobile GPU options? Fuggedaboutit.

WINNER: DESKTOP



The performance gap between mobile and desktop GPUs is shrinking.

Mobile CPUs are still lagging behind their desktop counterparts.



CPU

Just about all the high-end gaming laptops that arrive in our Lab come with quad-core i7 CPUs, but in all honesty, they hold a rinky-dink candle to their desktop counterparts. Comparing high-end mobile quad-core to high-end desktop quad-core, we're talking a delta of 40–50 percent. And that's not to mention the six- and eight-core CPUs desktops can offer.

Sure, some crazy beast laptops such as AVADirect's Clevo P570WM squeeze hexa-core desktop CPUs into their monstrous chassis, but notebooks like that are rare. Plus, you can't watercool them, meaning you can't unleash the beast to its full potential. To avoid overheating, laptop CPUs typically throttle themselves, and if they don't, they tend to sound like shop vacs. Not great.

But arguably the biggest win for the desktop column here is the modularity factor. You just can't beat swappable CPUs.

WINNER: DESKTOP

Sound

Years ago, laptop speakers were weak pieces of crap. But these days, while they may not please the harshest audiophiles, most high-end gaming laptops now offer plenty of volume firepower. Hell, some even offer a 2.1 setup with a bass speaker underneath the chassis. And you don't have to spend a fortune to get good audio from a gaming notebook. Lenovo's Y500 gaming series, which retail around \$1,000, offer great-sounding speakers licensed by JBL.

This should be an easy win for gaming laptops, right? Unfortunately, sound goes both ways, and fan noise is a major factor. A good laptop like the Asus ROG G751 will run near silent under load, but something that's too powerful for its britches, such as the AVADirect Clevo W230ST, can sound annoyingly loud.

Your mileage may vary here, but with both ends of this spectrum to consider, we're calling it a draw.

WINNER: TIE

RAM

Laptops aren't known to be modular, but most of them allow you to swap out RAM. In fact, some will even let you plop in up to 32GB, which is more than enough for gaming and everyday tasks. In terms of pricing, both are pretty competitive, with the cost equalling roughly \$10 per gig of DDR3 on either platform.

If we had to give one platform the nod, it would have to go to the desktop. Some gaming laptops, most notably the really thin ones, make it difficult to access the RAM slots. Typically, the only way to do this is to completely unscrew the notebook's base, which usually voids the warranty.

WINNER: DESKTOP

Storage

For a long time, smaller 2.5-inch laptop drives have generally been smaller and/or pricier than traditional 3.5-inch HDDs. With SSDs coming down in price and increasing in storage capacity, however, laptops can now offer a decent amount of storage at a reasonable cost. And with m.sata SSDs being so tiny, you don't have to sacrifice thinness for storage space. Still, it's almost comical to even compare the advantages of a desktop when it comes to storage, where your biggest limiting factor is how many SATA ports you have. This means you aren't constrained to using just 2.5-inch laptop drives. Knowing you can expand your storage by 4TB simply by plugging in one SATA cable... that's a good feeling.

WINNER: DESKTOP

Keyboard

We all love our mechanical keyboards, which have been a mainstay of gaming desktops for years, so you're probably thinking this is an easy win for the desktop column, right? But while most gaming laptop keyboards merely get the job done, they are also "free." In addition, you could always hook up a mechanical keyboard to your gaming laptop if you need to get your clickity-clackity fix. While you may scoff this off as awkward, it's actually fairly common at big national LAN events.

Furthermore, some gaming laptops like MSI's GT80 will be shipping with integrated mechanical

The rise of the SSD has meant big improvements for laptop storage.



keyboards, though the jury is still out on how well they'll work.

WINNER: LAPTOP

Monitor

There's a lot of quality variance when it comes to laptop monitors. We're beginning to see a lot of UHD panels out there, and then there's also the IPS versus TN facet to consider. Most gaming laptop monitors come in the 60Hz variety, unless they support stereoscopic 3D, but those have been rare birds since stereoscopic 3D glasses failed to take off.

But even if you've got a crummy 1080p TN display, you could always plug a nice discrete monitor into the laptop. Like the keyboard category, free is better than not free, and you still get the discrete monitor.

The one big downside is that laptop displays are smaller, and you can't raise their screens with a stand. Those quibbles aside, though, free monitor beats not-free monitor.

WINNER: LAPTOP

Portability

Desktops may have the power and the modularity, but it's tough to beat the portability that a laptop offers. Even if you could get a powerful PC in a relatively small mini-ITX form factor, they're still bigger and heavier than the fattest gaming laptops out there. Plus, you've got to lug around a monitor, keyboards, and cables galore. For situations like LAN parties, ain't nobody got time for that.

WINNER: LAPTOP

CONCLUSION

With the freedom to easily swap out components, coupled with the power they offer, it's clear the desktop PC isn't going anywhere. Having said that, however, as good as the desktop platform is, you shouldn't dismiss gaming laptops too swiftly. They've come a long way and are getting more powerful with each passing year. Believe it or not, the performance gap is narrowing (though it's unlikely to ever catch up completely). Furthermore, a lot of the other issues that have plagued gaming laptops, like size, weight, and noise, are slowly being ironed out.

In short, we think you should allow plenty of room at the table for both a desktop and a gaming laptop.

MODERN HIGH-END MOBILE GPUs

A closer look at what you can achieve with a laptop

To the right are charts showing the latest and greatest mobile GPUs from both Nvidia and AMD. Keep in mind that because of architectural differences, numbers should only be considered across the same brands, not across the board, for an accurate apples-to-apples comparison.

Even then, the comparison can be misleading. Nvidia's latest Maxwell GPUs, for instance, have CUDA cores that do far more pixel processing per clock than the older Kepler tech. So, the 1,536 cores in the 980M are far more powerful than the same number of cores in the 880M. That said, AMD uses pretty much the same GCN stream processors across its current model range.

NVIDIA MOBILE GPUs*

	860M	870M	880M	970M	980M
Cuda Cores	1152 or 640	1344	1536	1280	1536
Base Clock (MHz)	797 or 1029	941	954	924	1038
Memory Clock (MHz)	Up to 2500	Up to 2500	Up to 2500	2500	2500
Memory Interface	GDDR5	GDDR5	GDDR5	GDDR5	GDDR5
Memory Interface Width	128-bit	192-bit	256-bit	192-bit	256-bit
Memory Bandwidth (GB/s)	80	120	160	120	160

AMD RADEON MOBILE GPUs*

	R7 M265	R9 M265X	R9 M270X	R9 M275X	R9 M290X
Engine Clock (MHz)	Up to 825	Up to 625	Up to 775	Up to 925	850
Memory Interface	Up to 4GB DDR3	Up to 4GB	Up to 4GB	Up to 4GB	Up to 4GB
Memory Clock (MHz)	1000	1125	1125	1125	1200
Memory Interface Width	64-bit	128-bit	128-bit	128-bit	256-bit
Memory Bandwidth (GB/s)	Up to 32	72	72	72	153.6
Stream Processors	384	640	640	640	1280

*Memory GB count was left out because it can vary depending on model of laptop.

NVIDIA'S BATTERY BOOST REVISITED

Revised power management now delivers. A little...



Battery Boost defaults to 30fps, but you can change that.

If you can remember our August 2014 issue, we weren't too impressed with Nvidia's Battery Boost when it came out. For the uninitiated, the feature throttles gaming performance to optimize battery life, but we saw little-to-no gains. Nvidia acknowledged an issue and has been trying to rectify that with its mobile Maxwell GPUs. We tested it with our Asus ROG G751, with its Nvidia GTX 980M, and saw a small gain this time.

For our benchmark, we did A/B testing by looping the *Tomb Raider* graphics benchmark until our G751 died. With Battery Boost disabled, the laptop ran around 50fps average and lasted 70 minutes. With Battery Boost enabled, we got 80 minutes. Ten minutes extra may not sound much, but a 15 percent bonus is nothing to sneeze at. But keep in mind, you'll be trading frames per second for those extra minutes, as Battery Boost defaults to 30fps, though you can change the frame rate target. All in all, it's a small gain, and you won't be leaving your laptop charger behind anytime soon.

LAPTOP VS. DESKTOP: CRUNCHING THE NUMBERS

Can mobile GPUs really offer 80 percent of the performance of their desktop siblings?

Nvidia claims its 980M GPU can muster 70–80 percent of the horsepower its desktop sibling offers, and so this month we decided to put that claim to the test by pitting Asus's new ROG G751 against a 980 GeForce GTX box we put together ourselves.

We ran a host of gaming benchmarks at maximum settings at both 1080p and 2560x1600 resolution across both systems. We also threw a high-end quad-core CPU into our box—specifically, Intel's i7-4790K Devil's Canyon processor—because we wanted to see how a high-end quad-core desktop CPU stacks up against a high-end mobile equivalent.

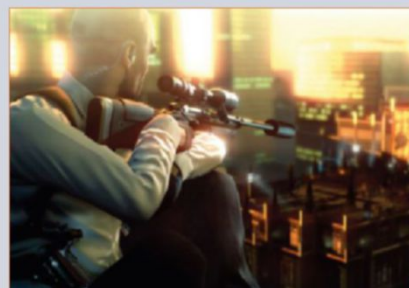
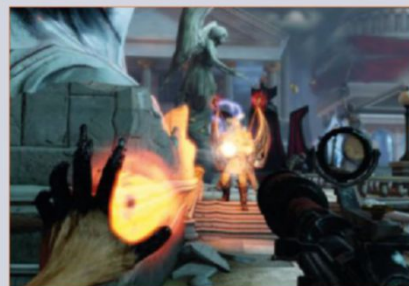
How did the two compare? While Nvidia's claim wasn't totally off-base, there were only two tests in our graphics benchmarks in which it really lived up to the claim. The mobile GPU version of *Batman: Arkham Origins* at 1080p and 3D Mark 11 at Extreme settings both ran over 80 percent as fast as its desktop counterpart, which was surprisingly impressive.

The rest of the numbers, however, don't stack up nearly as well. We saw the largest split in *Bioshock Infinite* at 1080p, where the mobile GPU got blasted by roughly 80 percent. The rest of the GPU benchmarks

show leads for the desktop GPU by roughly 35–45 percent, which is still quite impressive given the fact the 980 GTX desktop is a badass graphics card.

From an experiential perspective, our Nomad laptop is equipped with a 1080p monitor, and with the exception of *Hitman: Absolution*, which is quite the system hog at maximum settings, the system was overkill and played any game we threw at it well over 60fps. When we hooked up the laptop to a 2560 display, however, *Hitman* became unplayable at maximum, reporting average frame rates in the mid-20s. *Batman: Arkham Origins'* frame rates nearly split in half. As powerful as these mobile GPUs are, high-resolution displays do a great job of highlighting the importance of having a kick ass desktop GPU.

But what of the CPU side? It was surprisingly unanimous across the board in favor of Devil's Canyon, by about 45 percent. Ultimately, then, there's no getting away from the thermal and power constraints of a mobile form factor. The laws of physics simply get in the way.



Nvidia's GPU boasts rang true for *Batman*, but *Bioshock* and *Hitman* fared less well.

BENCHMARKS

	Laptop (1080)	Desktop (1080)	Laptop (2560)	Desktop (2560)
Stitch.Efx 2.0 (sec)	999	698	N/A	N/A
Proshow Producer 5 (sec)	1,709	1,176	N/A	N/A
X264	14.1	20	N/A	N/A
Batman: Arkham Origins	83	94	47	69
Bioshock Infinite	68.2	125.6	56.8	78.7
Hitman: Absolution	42.2	56.6	24.2	32.3
Unigine Valley	49.6	66.3	27.1	36.8
3D Mark 11 (Extreme)	4,729	5,714	N/A	N/A

Best scores are bolded.

ASUS ROG G751

The most powerful single-GPU laptop we've tested



The G751 is silent
and deadly.

W

hen we reviewed our original Asus ROG G750 back in the June 2014 issue, we liked it. We liked it a lot. We ended up awarding it a “9 Kick Ass!” With its then top-of-the-line GeForce GTX 880M GPU, it killed it in gaming performance. It was also eerily quiet under load. Asus is hoping to recapture lightning in a bottle with its new G751, which is equipped with Nvidia’s latest mobile darling, the GeForce GTX 980M. It’s certainly the most powerful mobile GPU we’ve ever tested in our Lab, but the laptop, unfortunately, isn’t without its blemishes.

The chassis remains largely the same, with a body measuring 16.4 x 12.5 x 0.9-inches. It’s also still very heavy, even by 17-inch gaming laptop standards, weighing in at 9 pounds, 3 ounces. Aesthetically, there are a couple of changes we’re not crazy about. The first ROG we reviewed had a *Dark Knight* tumbler batmobile vibe, with its white LED-backlit keyboard coupled with its rugged, futuristic black chassis. But if the previous incarnation looked like something out of a Christopher Nolan Batman film, then this gaudier take looks a bit like something out of Joel Schumacher’s garish *Batman & Robin* flick. This time around, Asus decided to apply a liberal use of red highlights across the body. The backlit keyboard we can stomach, but the shimmering red vents on the back look awful.

As far as GPU performance is concerned, we’ve no complaints. For a 1080p gaming laptop, the 980M is mostly overkill. The video card’s GPU is clocked at 1,038MHz, has 1,536 CUDA cores, and has 4GB of GDDR4 RAM that’s clocked to 2.5GHz. It made our Alienware 14 zero-point’s GTX 765M look extremely dated in comparison by obliterat-

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	962	999 -3.7%
Proshow Producer 5 (sec)	1,629	1,709 -4.7%
x264 HD 5.0	70	80
Bioshock Infinite (fps)	36.1	115.4
Metro Last Light (fps)	30.4	106.3
3DMark 11 Perf	4170	11,222 169.1%
Battery Life (min)	234	185 -20.9%

Our zero-point notebook is an Alienware 14 with a 2.4GHz Intel Core i7-4700MQ, 16GB DDR3/1600, 256GB mSATA SSD, 750GB 5400rpm HDD, a GeForce GTX 765M, and Windows 7 Home Premium 64-bit. *BioShock Infinite* tested at 1920x1080 at Ultra DX11 settings; *Metro Last Light* tested at 1920x1080 at DX11 medium quality settings with PhysX disabled.

ing it by 170-250 percent in our GPU tests. What this means in real-world terms is that it can basically max out 99 percent of games at 1080p with silky-smooth frame rates. It’s a shame the ROG doesn’t come with a 2560-resolution panel because its GPU is really equipped to deal with that resolution, though it wouldn’t be able to max the most intensive of games at that res.

We also really liked how the laptop was extremely quiet under load. It’s able to get away with this by having a copper heatsink coupled with dual fans, which contributes to the weight of the laptop, a tradeoff that we feel is fair.

Game time

CPU performance, on the other hand, was lackluster. Its 2.5GHz Intel Core i7-4710HQ is not necessarily terrible, but it was roughly 4 percent slower than our zero-point’s 4700MQ in our single-threaded benchmarks. It’s not a huge difference, but it’s disappointing considering the G751 is retailing for \$2,500 and is much newer. Fortunately, it was able to gain a 4 percent lead in our multithread-heavy X264 benchmark.

Another disappointing factor about the laptop pertained to battery life. It’s still equipped with an eight-cell battery, but it only lasted 185 minutes in our video run-down test. This is roughly 100 minutes less than the original G750 we reviewed.

The laptop still uses the same panel this time around, and it’s not bad for a TN display, but when you’re paying for a premium gaming notebook, it’s a little unfortunate to have to put up with something less than stellar.

We had little to complain about the feel of the keyboard, however. In addition to being backlit, it offers a bevy of added buttons this time around, which include three dedicated macro keys, a button that launches Steam

SPECIFICATIONS

CPU	2.5GHz Intel Core i7-4710HQ
RAM	24GB DDR3/1600
Chipset	Intel HM87
GPU	Nvidia GeForce GTX 980M
Display	17.3-inch, 1920x1080 TN display (matte)
Storage	1TB (7,200rpm) HDD, 256GB SSD
Connectivity	Ethernet, HDMI, Thunderbolt port, media card reader, 4x USB 3.0, mic input, headphone input, 2MP webcam, Bluetooth 4.0, 802.11n, Blu-ray writer
Lap / Carry	9lb, 3oz / 11lb, 3.8oz

Big Picture Mode, and a button that launches Nvidia ShadowPlay.

The Asus ROG G751 certainly has flaws, but as a gaming laptop, this thing has it where it counts, and that’s gaming performance. At \$2,500, it isn’t cheap, but we’ve seen more expensive laptops in the past that can’t touch the performance of this beast. It’s kind of crazy to see just how far mobile GPUs have come in closing the performance gap with their desktop counterparts. If gaming performance and quietness is what you care about most, the G751 is the gaming laptop to buy. 🗨

VERDICT

9

Asus ROG G751

★ **ROG** Killer gaming performance; extremely quiet.

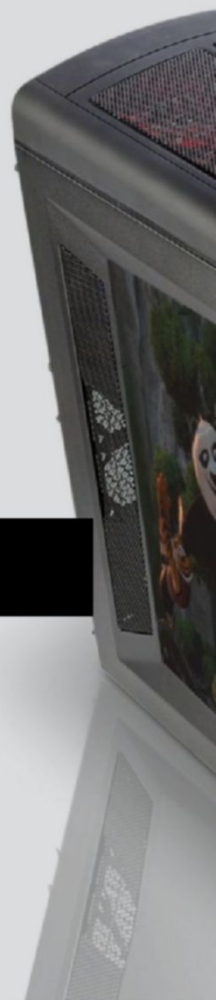
❌ **HOG** Heavy; mediocre battery life; average CPU performance; TN panel.

\$2,500 www.asus.com

GAME STREAMING 101

Everything you need to know
about game streaming and
what it means for the PC

BY MARCO CHIAPPETTA



- > Setting up your network
- > Fixing your in-game settings
- > Which games/devices work?



Game streaming is huge. It accounts for epic amounts of web traffic and is even an integral part of some companies' survival strategies. Look no further than Nvidia's GRID and GameStream technologies, plus the meteoric rise of Twitch.tv's traffic—it's now the fourth largest peak traffic producer on the Internet, just behind Apple and ahead of Hulu—to know that game streaming is big business.

Billions of dollars are spent on games every year and being able to access them in some form from virtually anywhere, and on any device, is appealing to almost all gamers. Developers are keen on the technology, too, because they can make their game for one platform and stream it to almost any other.

But streaming means different things to different people. For some it's broadcasting their game so fellow players can check out their skills. To others, it's running games on a local PC, but streaming the action to another device, like a tablet. It can also mean playing games that live in the cloud—no PC required. Each of these is completely different, but they're all "game streaming."

Regardless of how you define it, there's a lot to consider. There are control mechanisms, hardware and software configurations on the client, server, and network sides to account for, and a myriad of possible bottlenecks and pitfalls in between. But fear not, we've got you covered. We'll take you through the many methods currently available and explain some of the issues you may encounter along the way.

GAME STREAMING: AN INTRODUCTION

How does it work, what are the potential problems, and who are the major players?

There's a lot of complex engineering involved in getting game streaming "right." At its core, however, the concept is fairly straightforward. When you break things down, every game is essentially a collection of frames displayed on-screen that are affected by the gamer's input. Multiple things must happen to run and interact with that game, but the on-screen imagery, audio, and interaction are what are ultimately conveyed to the gamer through the monitor, speakers, and input devices.

It works by taking some of the game's frames, converting them into a video stream on the fly, and transmitting the video out to a remote device. The game's control interface and audio is also sent to the remote device, whether it be another PC, a smartphone, or a tablet. On some levels, streaming is like an interactive YouTube video. Almost every device currently available can smoothly stream a video from a site such as YouTube. But not every device can render and run a complex game. By leveraging the horsepower of a more capable machine to actually run the game, and then converting the game feed into a video stream, gamers can watch and/or play their game from a different device.

Taking control

The challenges associated with game streaming are significant, though. Modern hardware of all types (GPUs, mobile SoCs, CPUs and APUs, etc.) typically have the



Nvidia's GRID technology is the foundation of many game streaming services.

ability to encode HD quality video in real time with adequate frame and bitrates, so generating a video feed and broadcasting it out to another device isn't an issue for the most part. And neither is streaming the audio, though streamed in-game audio tends to be sent as a stereo signal to save on bandwidth—not multichannel surround.

The control schemes, however, can be tough to get right. Not only are there the plethora of input methods to consider, such

as touchscreens, game controllers, plus keyboards and mice, but the lag associated with sending/receiving inputs can make a gamer feel disconnected from the game. If a game stream suffers from noticeable lag, or latency, the action on screen won't be affected quickly enough, and the experience is degraded. As such, making effective use of available bandwidth and minimizing lag are the keys to good user experience. Image quality is also important, of course, but that's easier to control by altering game settings or increasing compression on the video stream. Masking and minimizing lag is far more difficult.

The game-changers

There are a multitude of companies involved with game streaming at the moment. AMD, Nvidia, Microsoft, Valve, Sony, and many others are directly involved with, or are inventing the technologies, that make game streaming possible or will enable new use cases in the future. Nvidia in particular is aggressively pushing game streaming forward on the PC, Android, and in the

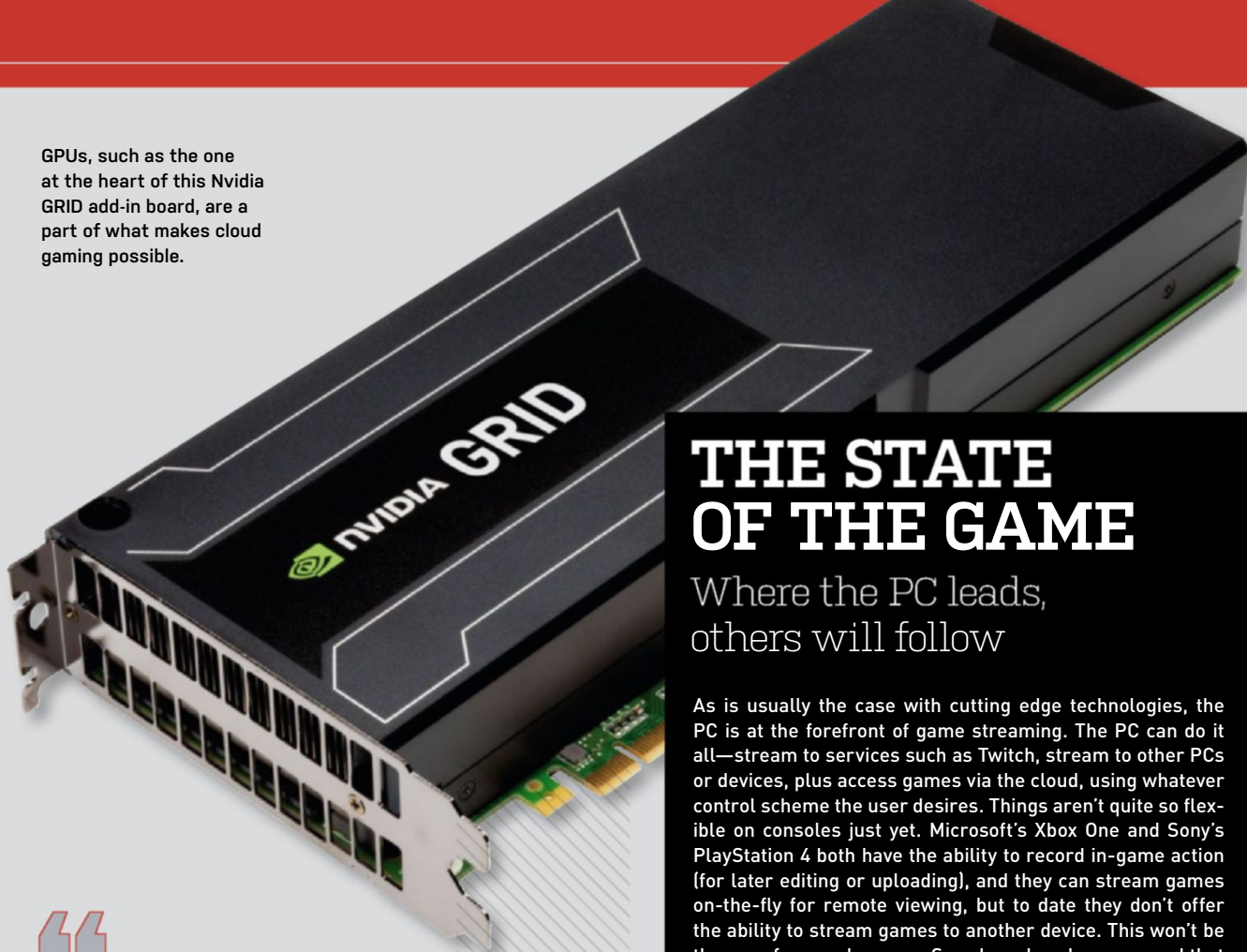


G-cluster allows users to play games direct from the cloud, across numerous devices.



As does Playcast, offering gamers unlimited play via their TV for around \$10 a month.

GPUs, such as the one at the heart of this Nvidia GRID add-in board, are a part of what makes cloud gaming possible.



Gamers flock to Twitch, some for the entertainment, others for tips and tricks.

cloud. In fact, Nvidia's GRID technology is arguably the de facto standard of most game streaming services. GRID is available from Amazon Web Services (AWS) and allows companies from around the world to rent capacity to build streaming services. GRID's partners currently include companies such as G-cluster, Playcast, Gload, Ubitus, and others. Nvidia was also involved with Gaikai before it was acquired by Sony.

There are also non-gaming companies (we use that term loosely) involved in game streaming. Twitch.tv, for example, doesn't necessarily provide any gaming-related services per se, but millions of people stream their games to the site nonetheless. Twitch doesn't facilitate remote game play or offer interaction with the game stream, over and above chatting with the game streamer, but gamers still flock to the site in droves. Some visit Twitch for the entertainment factor alone, while others use it to find tips and tricks for their favorite game.

THE STATE OF THE GAME

Where the PC leads, others will follow

As is usually the case with cutting edge technologies, the PC is at the forefront of game streaming. The PC can do it all—stream to services such as Twitch, stream to other PCs or devices, plus access games via the cloud, using whatever control scheme the user desires. Things aren't quite so flexible on consoles just yet. Microsoft's Xbox One and Sony's PlayStation 4 both have the ability to record in-game action (for later editing or uploading), and they can stream games on-the-fly for remote viewing, but to date they don't offer the ability to stream games to another device. This won't be the case forever, however. Sony has already announced that some upcoming Xperia-branded mobile devices will be able to stream PS4 games, while its acquisition of Gaikai and its PlayStation Now technology (which is currently in Beta) will eventually permeate a number of Sony's gaming products.

Note, however, that certain types of game streaming are better suited to specific types of device. At this point in time, gamers have the ability to stream from PC to PC, from a PC (and soon console) to a mobile device or streaming video service, or directly from the cloud to a device. If you've got a powerful PC, it doesn't make much sense to stream games from the cloud or another PC, since the best experience will be had by gaming locally. Gaming locally on a powerful PC ensures maximum image quality, minimal lag, and it eliminates potential bottlenecks on the network or web. With less powerful devices like a tablet, however, it may make sense to stream games from more powerful systems that can render imagery with more detail than may be possible on the device itself.



You can't currently stream games from consoles to other devices, like PCs can, but that's likely to change soon.

WHAT DO I NEED TO STREAM MY GAMES?

The specs, the network requirements, and the game settings that will get you streaming

The hardware requirements aren't steep. Just like running a game, the more processing power behind the host machine, the less taxing streaming will be on the system. But assuming you've got the hardware to accelerate the video encoding process (and almost every system sold in the last few years should), an adequate amount of memory, and decent broadband, then a fairly modest system will work just fine.

Both Nvidia's GameStream and Steam's In-House Streaming recommend using a quad-core Intel CPU (or six-core AMD processor). We'd also suggest having at least 8GB in the system. As always, more memory is better. The client systems have more modest requirements, however. They should have a GPU with built-in hardware accelerated H.264 decoding, but just about any modern computer or device should have that. If you can smoothly play high-quality HD video streams, you should be good.

Getting wired

The network requirements are a bit trickier and arguably more important. Not only must there be adequate bandwidth between the game streaming host and client system, but low latency is paramount as well. Ideally you'd have all systems wired to the same network via a network switch, but even a 100Mb connection would offer more than enough bandwidth. Nvidia recommends a 10Mb/s upstream and 2Mb/s downstream, which is nothing for a modern wired network.

Should you have to use a wireless network, a fast, dual-band 802.11ac or 802.11n router/access point would be the next best setup. Nvidia has even worked with a number of partners to certify wireless network devices as GameStream-ready (check out <http://bit.ly/11jtnC3>). Also note the clients connecting to the wireless access point should feature matching network controllers. It's best to be in close proximity to the router to ensure a strong signal, and to employ the cleanest channel to minimize interference. Our "Ultimate Router Guide" (<http://bit.ly/1vs9YvW>) has

stacks of suggestions. Streaming outside of your local network is possible, but you'll be at the mercy of your broadband provider.

Image quality

Game settings matter—lower resolution will require less bandwidth, while turning off vertical sync will help minimize input lag. In-game image quality, resolution, frame

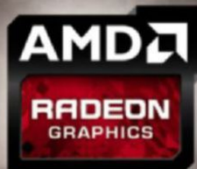
rates, and bitrates can all usually be altered, and finding the right balance between image quality, bandwidth, and latency/lag is key to a good experience.

We've found that game streaming locally is typically awesome if you meet the minimum system requirements and have a fast home network. Steam's In-Home Streaming and Nvidia's GameStream on the Shield Portable and Shield Tablet often seem just as good as playing on a local PC. Game streaming from the cloud isn't always perfect, but will improve as broadband speeds rise and more servers are introduced into the ecosystem. As Nvidia adds more servers, the user experience for GRID should improve since the load will be shared and gamers can access servers closer to their location.

“The balance between quality, bandwidth, and latency/lag is key.”



The Shield Portable and Shield Tablet can stream from a PC or the cloud.

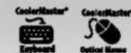


CREATE THE PC OF YOUR DREAMS



Windows 8.1

AMD FX-9590	\$ 939
AMD FX-9370	\$ 855
AMD FX-8350	\$ 845
AMD FX-8320	\$ 775
AMD FX-6300	\$ 765
AMD FX-4350	\$ 745

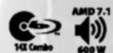


From
\$745



Windows 8.1

AMD FX-9590	\$ 1209
AMD FX-9370	\$ 1129
AMD FX-8350	\$ 1115
AMD FX-8320	\$ 1049
AMD FX-6300	\$ 1019
AMD FX-4350	\$ 999



From
\$1069



Windows 8.1

AMD A10-7850K	\$ 725
AMD A10-7700K	\$ 699
AMD A8-7600K	\$ 656
AMD A6-7400K	\$ 629
AMD A4-7300	\$ 585
AMD Athlon X4 840	\$ 599



From
\$599



AMD Quad-Core A10-5750M Processor

Windows 8.1





8X±BW 2 hr Built-in

AMD A10-5750M **\$1159**

- HDMI
- IEEE 1394
- 3 x USB 3.0
- 7.9 Lb.
- 4 in 1 Media Reader

www.cyberpowerpc.com 800 707 0393 730 Baldwin Park Blvd., City of Industry, CA 91746

All Desktop systems come with 3 year Limited Warranty + lifetime toll free techsupport

AMD, the AMD Arrow logo, AMD Phenom™, AMD Phenom™ X3 ATI Radeon™ Graphics, 790 Series, and combinations thereof are trademarks of Advanced Micro Devices, Inc. All prices are subject to change without notice or obligation. Overpower! is not responsible for any typographical and photographic errors. Copyright ©2013 Windows® All rights reserved. NVIDIA®, nVidia®, GeForce®, SLI™ are trademarks or registered trademarks of NVIDIA Corporation or its subsidiaries in the United States and other countries. Overpower! PC also contains Microsoft® Windows® + www.microsoft.com/windows/overpower!

Work easy, play hard Windows 8



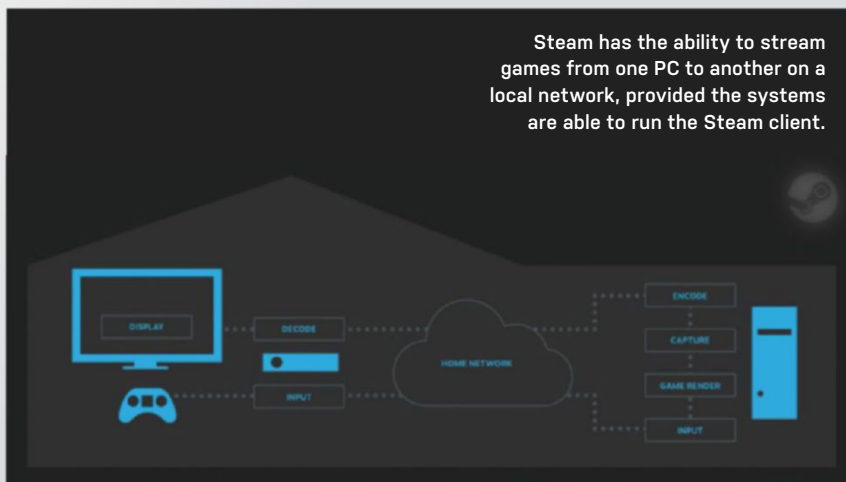
Windows 8

GAME STREAMING WITH STEAM, NVIDIA, AND AMD

Setting up made simple

As a *Maximum PC* reader looking to experiment with game streaming, odds are you'll already have access to Steam, or Nvidia or AMD GPUs. With that in mind, we thought we'd explain how to utilize Steam's In-Home Streaming, Nvidia's GameStream, and AMD's Gaming Evolved utility to stream games between PCs, between a PC and mobile device, and from a PC to Twitch.

Although they have some features in common, there are fundamental differences between Valve's, Nvidia's, and AMD's current solutions. Steam, for example, can stream games between systems on a local network that are capable of running the Steam client (currently available for Windows, Linux, and OSX). Nvidia's GameStream technology can stream games from a PC to an Nvidia Shield device on a local network or across the web, provided there's enough bandwidth available and the latency is acceptable. Nvidia also gives owners of its Shield devices access to the company's GRID service to stream PC games directly from the cloud, though the service is still in beta. AMD's Gaming Evolved utility (by Raptr) doesn't have any built-in mechanism for streaming games to other devices, but it can stream and record in-game action for remote viewing on Twitch.tv. We should note that Nvidia's GeForce Experience app with ShadowPlay support can also record and stream in-game action, but we're not going to cover that here.



Steam has the ability to stream games from one PC to another on a local network, provided the systems are able to run the Steam client.

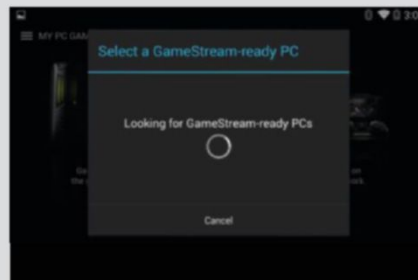
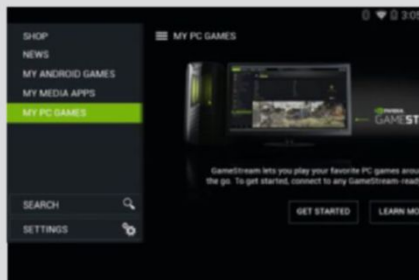
Steam In-Home Streaming

Using Steam's In-Home Streaming is incredibly simple. All you need to do is run the Steam client on systems connected to the same local network and log in with the same account on all of the machines. The host machine, as in the machine that actually houses and runs the games, must be a Windows-based PC at this time. When you log into the client machines, the option to stream games from the host will be available in the game library. Simply click on the streaming icon for that game and

you'll be off and running. Should you need to tweak the game stream for any reason, Valve offers a number of suggestions on its support site (<http://bit.ly/1cZRUDF>).

Nvidia GameStream

Streaming your PC games to an Nvidia Shield device is also relatively straightforward if you meet the necessary requirements. You'll need to have an Nvidia GeForce GTX-branded graphics card installed in the host machine, powered by a Kepler or Maxwell-based GPU. GameStream (and GRID) uses Nvidia's hardware H.264 video encoder



A GeForce GTX-equipped PC running Nvidia's GeForce Experience application can stream supported games over a LAN or WAN.

PRE-ORDER
NOW

THE WITCHER WILD HUNT



OFFICIAL GUIDE FEATURES:

- **NEVER GET LOST** - Labeled maps show all points of interest for each area.
- **ENDINGS GUIDE** - How to unlock every ending in the game.
- **100% COMPLETION** - Full details on how to unlock each trophy and achievement.
- **ROBUST EGUIDE** - Purchase of the print guide includes full access to the eGuide, which features searchable tables, interactive maps and video strategy.

The Witcher® is a trademark of CD PROJEKT S. A. The Witcher game® CD PROJEKT S. A. All rights reserved.
The Witcher game is based on a novel by Andrzej Sapkowski. All other copyrights and trademarks are the property of their respective owners.
WB GAMES LOGO, WB SHIELD:™ & © Warner Bros. Entertainment Inc. (s15)



Say hello to the X-10

The Ultimate Watercooled PC



www.xidax.com

Elite Rigs Starting at \$799

Enter coupon code MAXPC for 5% off this month!



to encode and stream in real-time inside the GPU as a game is being rendered. This encoder is only available on Nvidia Kepler and Maxwell GPUs. You'll also need to have Nvidia's GeForce Experience application installed and running on the host PC. The GeForce Experience application will scan the system for compatible games and offer a list of suggested settings for the best game streaming experience. On the Shield device, all you have to do is access the Shield hub. In the menu on the left, an option labeled "My PC Games" will be listed. Select "My PC Games" and your Shield will scan the network and present the list of compatible games available in the GFE application.

Also note that Nvidia gives users the ability to stream games outside of their home network as well. Nvidia recommends Internet bandwidth of 10Mb/s from your PC down to Shield and 2Mb/s from Shield up to your PC. The streaming experience will vary depending on the quality of the connection, but it is possible.

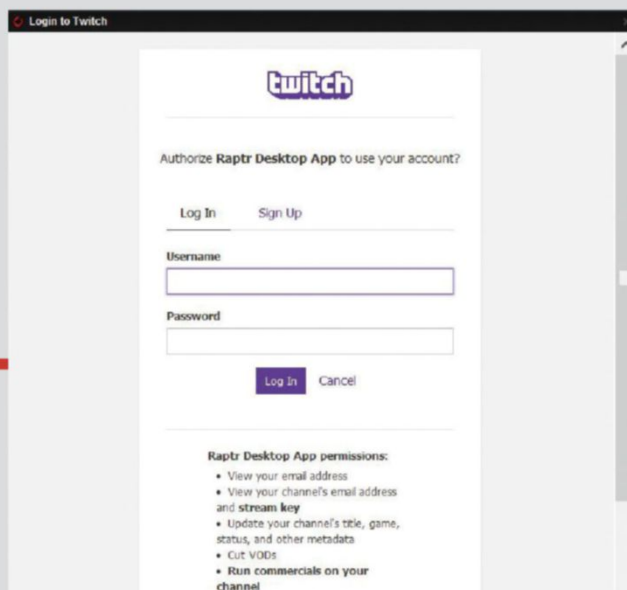
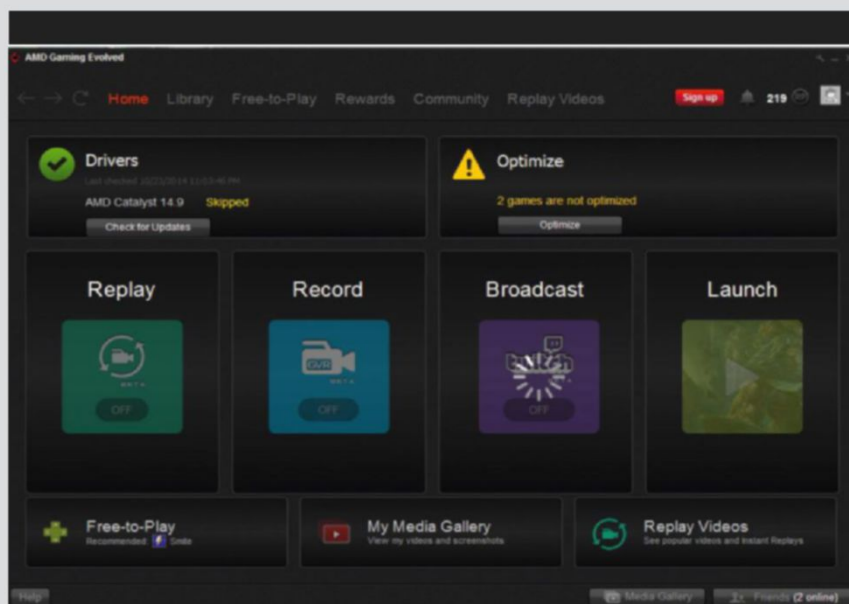
“Nvidia gives users the ability to stream games outside of their home network.”

AMD Gaming Evolved

Have an AMD GPU and want to stream your in-game activities to Twitch.tv? No problem. The AMD Game Evolved utility by Raptr, which gets installed as part of AMD's Catalyst driver suite, has the ability to record and stream to Twitch built right in.

First you'll need an account on Twitch. Once you've created an account, run the AMD Gaming Evolved app and click on the Broadcast button on the main interface. You'll be asked to log into Twitch—do that, then minimize the app. When you run a game, the Raptr overlay should be visible in the upper-left corner (if not, exit the game, access the Raptr preferences and enable under the "In-Game" menu). Then all you have to do is hit Page Up + B when in a game, give your stream a name, and then click the Start Streaming button.

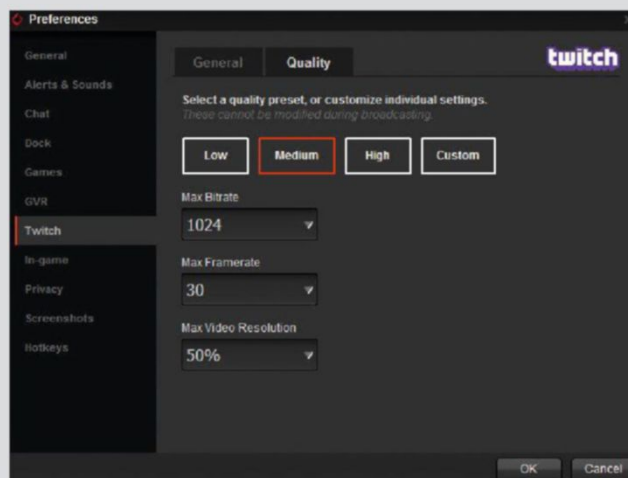
The speed/quality of your broadband connection plays a large part in determining the quality of your stream. If you need (or want) to alter the bitrate, resolution, or frame rate of the stream to improve quality or smoothness, they can be changed via the Twitch menu in the Raptr preferences menu.

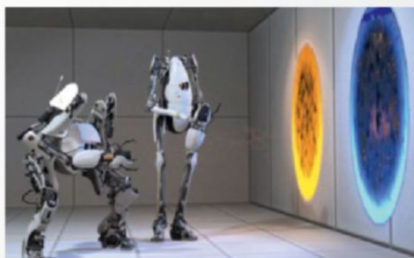


The AMD Gaming Evolved utility by Raptr can stream in-game action to Twitch with ease.

You'll need to set up a Twitch account first.

You can alter the presets to up your stream's quality.





The game genre might dictate your preferred input method.

CAN I STREAM MY GAMES?

Which games will work, and on which devices?

There are no hard and fast rules to determine which games are best suited to streaming, but there are some guidelines to follow to minimize frustration. If you're streaming from one PC to another PC (or another device with a mouse and keyboard), the network is arguably the most important link in the chain, because the control scheme is identical. For best results, the host PC should be wired. If that's not possible, the wireless connection needs to be strong and reliable—an 802.11n or 802.11ac 5GHz router/access point should be a requirement, though a good 802.11g router will technically work as well.

The game's preferred input method is also a major consideration. Nvidia has a huge list of games posted online that it's certified as compatible with its GameStream technology (<http://bit.ly/1wJigAm>), which also illustrates what types of controllers are supported. What you'll find is that many games support multiple controllers, but a particular type would be ideal for certain games. For example, shooters work best with a mouse

and keyboard or maybe a game controller, but they're less suited to touchscreens. Conversely, racing and sports games are perfectly playable with a game controller or touchscreen, but a keyboard and mouse aren't quite as intuitive.

Testing times

Then again, preferred input methods are subjective. Less subjective is our tolerance for latency. When the latency between the game server (the system running the game) and client (the one receiving the stream) is too high, the experience won't be good.

Ultimately, the games best suited to streaming are those compatible and playable with multiple controller

types. GameStream and In-Home Streaming are compatible with a wide range of titles in all genres, but game streaming isn't universally possible across all games and systems/devices. "To enable a GameStream game, Nvidia has to test each game in our lab," Nvidia's Andrew Fear, product manager for GRID, told us. "We leverage all of the testing that goes into the GeForce Experience optimal playable settings to develop profiles for each game we support."

"In addition, we have to test games to ensure they start up flawlessly and don't show any strange dialog boxes during gameplay. It's a big undertaking to do this for hundreds of games, but we are committed," Fear says. Some of the testing involves general compatibility, but Nvidia also ensures its Shield controllers are mapped properly, that the game's interface works and is displayed properly when streamed, and that the experience is generally good. Games not listed may still work properly, but they haven't been officially tested yet.



Shooters work best with a mouse and keyboard, they're less suited to touchscreens.

"The Perfect PC"
- Forbes

Tiki

GODLIKE
POWER

MICRO-
TOWER



www.falconnorthwest.com

THE FUTURE OF GAME STREAMING

Could single-platform games become a thing of the past?

For game streaming to go mainstream and become one of the preferred methods for gamers to get their fix, many things need to improve. Should all of the stars align though, there could be serious implications for the PC gaming industry. By its very nature, game streaming somewhat negates the need for gamers to own their own powerful PC or game console. A system of some sort capable of actually running the game must be available at some stage of the pipeline—most likely in the cloud—but the gamer's device receiving the stream need only have the ability to connect to a network, accept user input, and play-back the game video.

Theoretically, streaming games from the cloud could obliterate the consumer add-in GPU market. So, you'd think AMD and Nvidia would despise the technology, but

they don't. GPUs are still needed to render a game, whether it be local or in the cloud. And ideally, each game being streamed would have adequate GPU resources allocated to render it in the highest quality and for each gamer connected to the service. To that end both AMD and Nvidia have developed boards strictly for use in game streaming servers that can be virtualized to support multiple game instances simultaneously.

So, even though streaming could cannibalize local PC gaming, there's still huge potential for GPU makers and a need for significant GPU resources. They just may not live under your desk in the future—they'll be in the cloud.

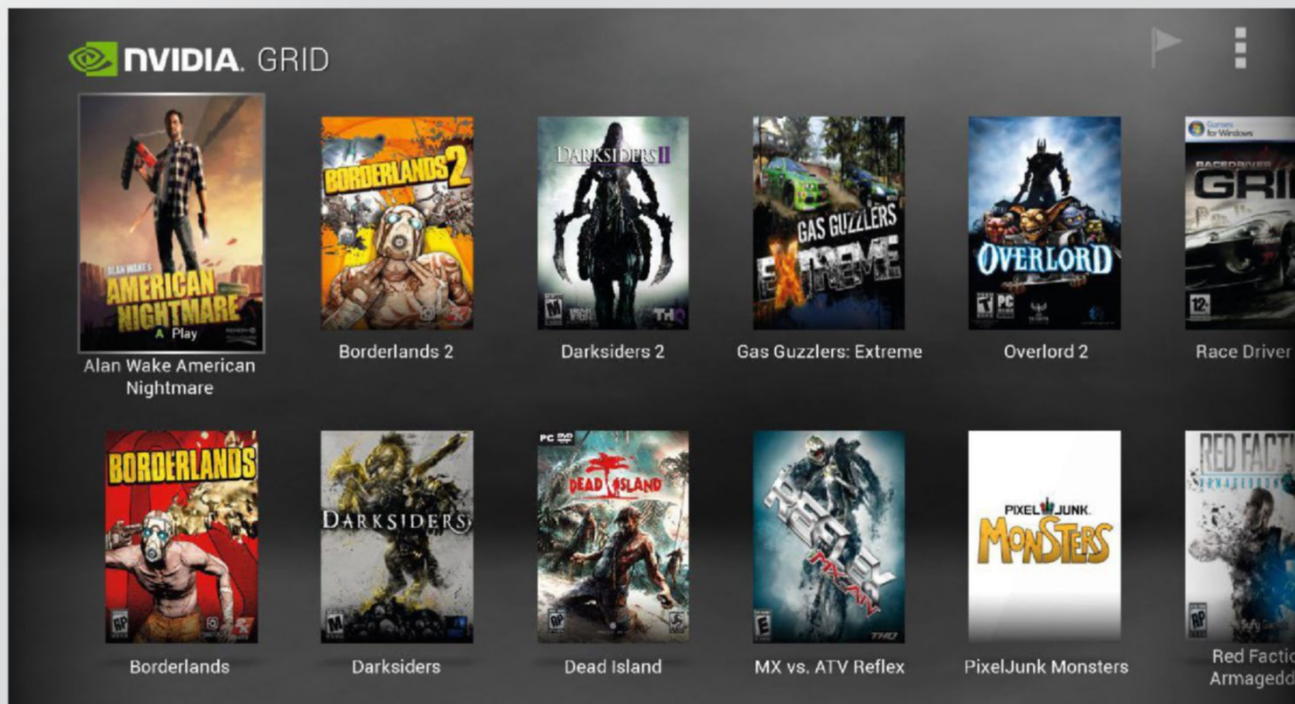
The cloud's the limit

When we asked Nvidia how it sees game streaming evolving in the future, it answered with, "Nvidia is committed to giving users as



Games will be rendered by a GPU in the cloud, rather than one under your desk.

many choices with their games as we can. We are gamers; we enjoy games on many different platforms and usage models. We want to give Nvidia customers choices: they can enjoy local PC games on their own GeForce PC, they can stream the games they own using GameStream, or they cannot even own a PC and stream games from GRID to a Shield." And that's really the crux of the issue and why game streaming is being actively pursued by so many players. Game streaming could ultimately give gamers more choice and developers more flexibility.



Nvidia is prepping its GRID service to stream PC games from the cloud, with excellent image quality and minimal lag.



In a single platform world, developers could be more flexible and creative.



Streaming games from the cloud could obliterate the consumer add-in GPU market.

As things stand, we usually have to buy games for a particular platform, be it the PC, Android, an Xbox, smartphone, or whatever. Developers also have to make the games for each platform. There are plenty of assets that can be carried over for each version, but developing and tuning a game for multiple platforms still requires a considerable amount of time and effort. If game streaming becomes the norm, developers may only have to develop and optimize a game for a single platform and gamers would play it on their preferred device. This scenario could change the way we buy games as well. Instead of buying a game for one platform, we'd simply be buying access to a particular game that can be played on any platform. We could play our games virtually anywhere and have all of our stats and save-games come with us.

A number of the existing cloud gaming services already give us a glimpse of this future. Nvidia's GRID or Sony's PlayStation Now betas allow gamers to play games—in these cases PC games (GRID) or PlayStation 3 games (Now)—on portable Android devices or other Sony gaming systems. But make no mistake, there's no technical reason limiting these services (and others) from working properly on virtually any device, from a smart TV to a smartphone. ☺

CONSOLE VS. PC VS. STREAMING

Consoles could be heading for the cloud

Game streaming has the potential to seriously disrupt the game console and PC businesses. The SoCs in many of today's smart TVs are already powerful enough to run the client software necessary to stream games from the cloud, and they've got capable video engines and network connectivity already built in, too. There could come a time when a powerful PC or a dedicated game console is no longer necessary to enjoy the latest games.

A lot still has to happen before that becomes a reality, however. The state of broadband in the U.S. (and many other countries) leaves a lot to be desired, and a fast, reliable broadband connection is paramount. Game streaming services must also evolve to the point where they can offer reliable, low-latency connections to all of their potential customers. And then there's the business model to consider—game developers and streaming service providers need to offer a product to gamers that's both affordable and enjoyable, that can also sustain the business. These aren't insurmountable hurdles by any means, but they aren't going to be resolved overnight.

We think gaming PCs will remain popular for years, however, and so does Nvidia. "We believe there will always be a place for local PC experiences with GeForce and remote game experiences with GameStream or GRID," said Andrew Fear. "But the power of our streaming technology does allow us to bring our entire library of GeForce-optimized PC games to a brand new platform," he added.

Panic over

Bottom line, a powerful gaming PC is and will remain the premiere gaming platform—bar none—and hardcore gamers aren't likely to give up all of the benefits of local gaming anytime soon. Consoles will probably be around for another cycle or two as well, but Sony and Microsoft are already developing cloud-based services, so it's possible next-gen consoles may be much smaller, thinner, and potentially less-powerful devices that rely on the cloud for everything from content delivery to rendering. We wouldn't be surprised if the next wave of "consoles" are actually licensed to television manufacturers that would integrate the necessary processors and input mechanisms directly into the televisions themselves. Time will tell.

As network speeds and capacities increase, and hardware becomes more powerful, game streaming services will continue to improve. There will probably come a time when game streaming offers an almost indistinguishable experience from gaming locally, but even if it doesn't, the allure of accessing games from virtually anywhere, on any device, will be compelling and we suspect gamers will flock to the services in droves. If (or when) that happens, the demand for high-performance gaming systems, packed with cutting-edge hardware, will be diminished greatly.

THE STATE OF PLAY

The gaming industry is booming,
but could it be heading for a crash?

BY HENRY WINCHESTER



On 26 April 2014, a team of documentary makers turned up part of an unlikely story in the arid expanse of the New Mexico desert: a trove of some 700,000 buried Atari cartridges. The discovery of this 8-bit burial ground, assumed for many years to be little more than an urban legend, was a reminder of the near-destruction of the videogame industry in the early 1980s.

A number of factors led to the spectacular crash. The industry was flooded with poor quality consoles, and the home computer was emerging in the form of the Apple II, the IBM 5150, and the Commodore 64. Consumers were becoming interested in a piece of hardware they could upgrade, rather than one with features rigidly set in stone by its manufacturer.

There were also great shake-ups within the industry itself. Atari employees, annoyed that they weren't paid royalties like their counterparts in the film and music industries, split from the company and formed Activision. Atari attempted to sue Activision for producing games for its consoles, but when the action was turfed out of court, it opened the door for numerous other third-party companies to also start creating games.

The result was a torrent of absurdly crap games that completely overwhelmed stores that were unprepared for, and uninitiated in, the ways of games. Atari didn't help matters by programming and releasing *ET* in just six weeks, resulting in one of the most notoriously awful titles in videogame history. The general public was disillusioned by the quality of games, and retailers began to write them off as a fad.

THE DIGITAL REVOLUTION

OnLive's Bruce Grove talks game streaming services



MPC: What have been the biggest changes in the games industry over the last few years?

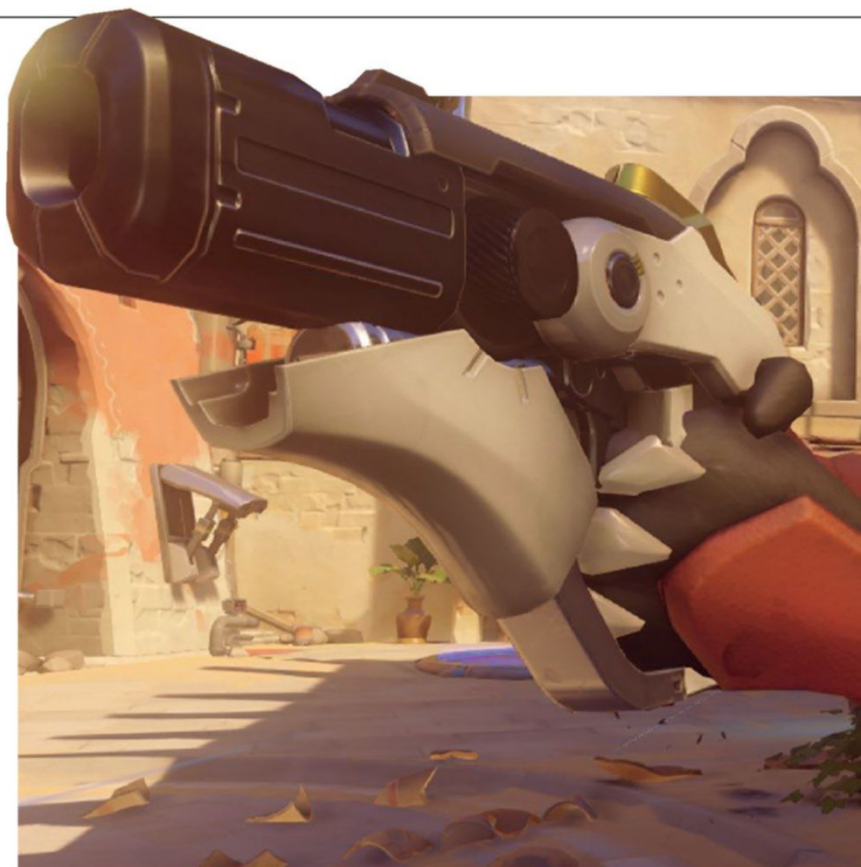
BG: Digital has been changing the industry for a while and it's not done yet. Whether you're looking at how games are delivered, the renaissance of the indie developer, the immediacy of social, or the draw of live video streams, all have been fuelled in some way by improving connectivity, and it's only going to get better. We're also seeing consumer expectations changing. People want to access their chosen entertainment quicker, on the device of their choice, wherever they are.

MPC: How does it work in terms of licences?

BG: OnLive has two offerings. PlayPack is very much like the Spotify or Netflix models where you have a constantly growing library of games that subscribers can play whenever they like, wherever they like, as much as they like. We also have CloudLift, which enables you to play your games library instantly from virtually any connected device. Currently we're working with Steam games, but the plan is to support more platforms going forward. This means you own the game licences. You can play it locally if you have a suitable PC; it's the same multiplayer and community features you're used to, but now you can play it anywhere.

MPC: What does the future hold for gaming?

BG: That's an easy one. Games will come in pill form, and we'll all be playing hover-PCs! Aside from that, as fiber and 4G roll-outs continue, we expect to see more people using cloud gaming as one of the ways they access their games. Potentially, this could slow the hardware cycles because a portion of the upgrading can happen server-side. Also—and this is based on almost five years of data of this OnLive feature—live video for spectating will take on an increasingly important role in influencing the games we buy or choose to play.



Major releases such as *Overwatch* can make or break even the biggest of studios.

The result was that in a matter of years a \$3 billion market became a \$100 million one.

Companies created to make a quick buck vanished as quickly as they appeared. Videogames were reduced from \$35 to \$5, and Atari's multitude of *ET* cartridges, along with titles such as *Centipede*, *Pac-Man*, and *Defender*, some consoles and—allegedly—some Mindlink controllers ended up buried in that desert.

It was a massive setback for the games industry, and one that allowed Sega and Nintendo—which survived by virtue of being in the more savvy Japanese technology market—to gain footholds in North America. The industry, it seems, learned its lesson. Tighter controls combined with newer, better business models have meant that despite its occasional failures, the entire shebang has never again come close to imploding on itself quite so spectacularly.

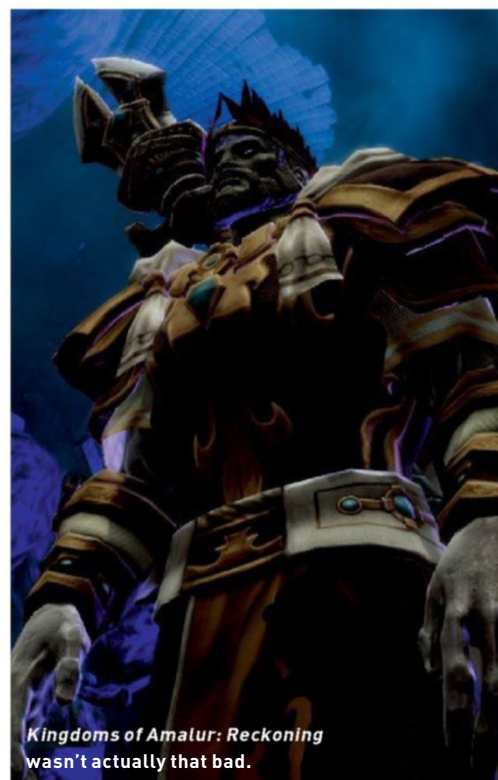
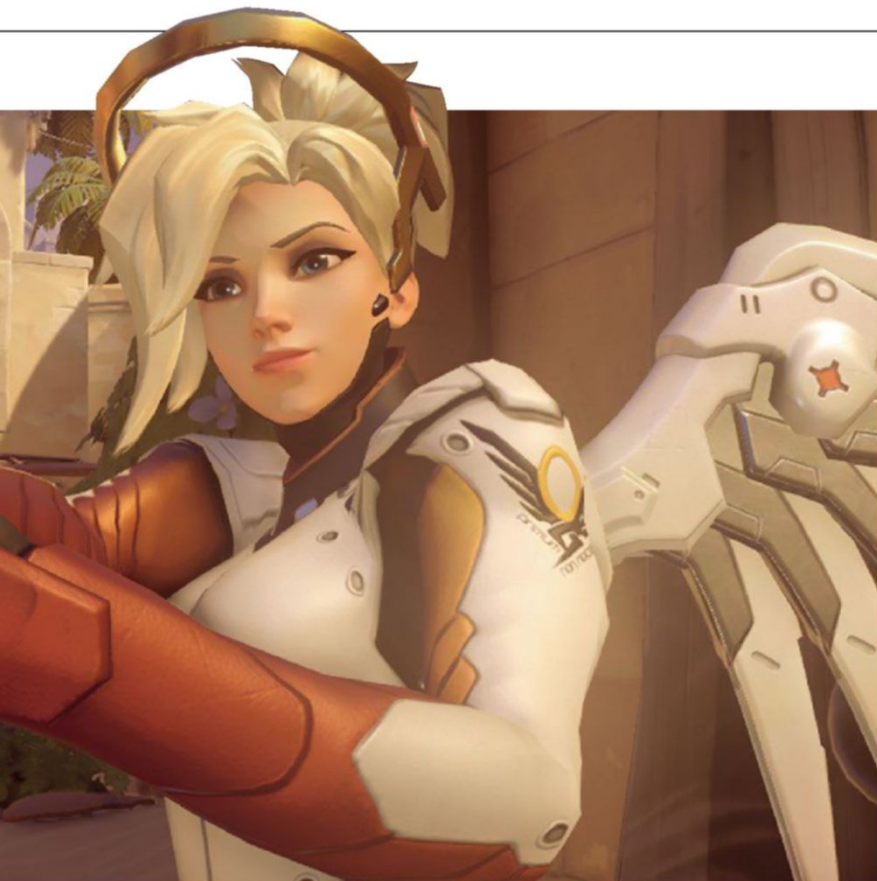
But we should never be too careful; there are signs that the industry is heading for another catastrophe. Here we cast a magnifying glass over the industry's current performance, from the cheapest ways to buy games to the half-billion dollar budgets that

companies are ploughing into them. Our quest: to find out if the market could ever crash so dramatically again.

A SURVIVOR'S TALE

In the fallout of the great crash the PC defiantly survived, like an irradiated cockroach. It also became a more realistic gaming platform, with industrious hobbyists creating their own videogames. By 1987 it had become the largest target market for games companies, and it continued to evolve incredibly quickly: VGA graphics, CD-ROM drives, and soundcards meant the desktop computer—even in its boring off-white housing—was many times more exciting than its console equivalents.

In terms of publishing, the PC around this time was still emulating the system employed by consoles. Publisher and developer were often one and the same, and it was a system that worked because publishers had enough cash to invest in potential flops without going under, as well as the supply and distribution networks to get games to the general public. But it also meant that smaller developers, which we'd probably now term "indies," were unable to get a look-in



unless they'd been contracted by a publisher to create a game—which happened very rarely at the time.

The method indie developers created to circumvent publishers was ingenious. Bedroom developers would issue the full versions of their games with certain restrictions—the final act would be locked, or a parrot would kill the player character (hello, *Escape Velocity*). These versions of the games, dubbed “shareware,” would be distributed via 3.5-inch disks mounted on the front of magazines or via mail order services.

SHAREWARE SHOWER

The result was that these versions spread like wildfire, an impressive feat given the Internet was only in its most nascent form, and unavailable to most. Even if a tiny fraction of

“ In the fall-out of the great crash the PC survived, like an irradiated cockroach. ”

players paid for the full game, it was worth it to the developers because their overheads were so low; they'd just got a million copies of, say, *Duke Nukem* into people's homes while spending barely a cent on marketing.

More important than the shareware distribution method was its message: the value of games didn't lie in their packaging or their marketing and advertising budgets—it lay in the lines of code that made them up, and nothing more. Again, the PC was at the forefront of this underground movement, and some of the format's most important games (*Doom*, *Wolfenstein 3D*, *Commander Keen*) were distributed this way.

The rise of the Internet gave developers a whole new way to distribute software in the late '90s, but glacial speeds and a lack of infrastructure meant most shareware and demo-ware was distributed via floppies and CD-ROMs rather than 56K dial-up.

By 2000, 3 percent of US adults had access to a broadband Internet

connection. Stardock, a company that published both games and Windows customization software, was the first to offer an online marketplace, dubbed Stardock Central. It wasn't until 2004 that digital distribution really took off, though, with Amazon Digital Services, GameStop, Games for Windows Live, Origin, and Steam all launching. Despite initial reservations—especially with regards to Steam, which was required to play Valve's *Half-Life 2*—digital distribution became a huge success.

DISCOVERING DIGITAL

Like games themselves, digital distribution services could now have unique selling points—Green Man Gaming allowed trade-ins, Good Old Games specialized in getting older titles painlessly up and running on newer hardware, and Origin would ruin your computer with crap games. While the games offered by these services were often the full titles, with a few demos here and

GREEN FUTURES

Green Man Gaming's executive VP of marketing Darren Cairns on digital distribution systems



MPC: The online games marketplace has changed a huge amount since Green Man Gaming started. What have you done to keep ahead?

DC: We've kept ahead by going beyond a sale! On top of having an extensive catalogue of nearly 6,000 titles, we offer customers the chance to earn GMG Credit for positive activity such as joining the service, writing reviews on the site, signing up to newsletters, or most importantly, playing games. With Playfire Rewards, we attach credit to a selection of titles. This credit is then earned as gamers play through and gain achievements. These games don't have to have been bought from us—gamers simply need to link their Steam account and sign up to the Rewards BETA to start earning.

MPC: You've recently branched out into console games. How does that market differ to the PC?

DC: We know modern gaming audiences are no longer loyal to one platform. Nearly half of the Green Man Gaming core PC audience owns a PS3 or PS4, while 43 percent own an Xbox 360 or Xbox One. As our audience play across platforms, our main focus still firmly remains on the PC market, which is extremely healthy, more diverse, and more relevant than ever before. In September 2014, Intel estimated the number of PC gamers to be 711 million. That's a large pool to fish in!

MPC: Games funded through Kickstarter mean indie developers can pretty much bypass publishers and do it themselves. Is that good for you?

DC: It's good for everybody! The ease of being able to self-publish means there's a greater number of high quality titles vying for attention, but many studios and developers still need help on overcoming the barrier to market entry, which is something we've strongly been championing. Using our specialist retail knowledge, we've been able to draw attention to self-published titles that might otherwise have gone under the radar.



Star Wars: The Old Republic apparently cost \$500 million to make.

“ If just one game fails, it can drag a whole developer or publisher down. ”

there, it very much carried the spirit of shareware from the early '90s—no packaging, and word-of-mouth taking precedence over marketing. Tying in critic systems such as Metacritic meant the way we valued games was altered drastically.

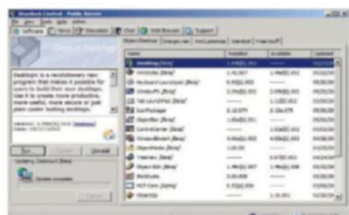
The lower requirements of digital distribution meant these services were free to take risks. In late 2009, Valve launched the first Steam sale, with then two-year-old titles *BioShock* and *Portal* reduced to \$4.99 and *Stalker: Shadow of Chernobyl* available for just \$1.99. While Steam has never released stats for the sale, the Internet was ablaze with people asking Steam to “shut up and take their money.”

Of course, this wasn't a sale in the conventional sense—Valve didn't have shelf after shelf of mouldy Twinkies or party frocks to peddle at

reduced prices. But it affirmed the idea that digital versions of games, which could be infinitely replicated (until, at least, you run out of Steam keys), and transported for next to nothing, could be sold in quantity and still turn a profit.

STREAM OF CONSCIOUSNESS

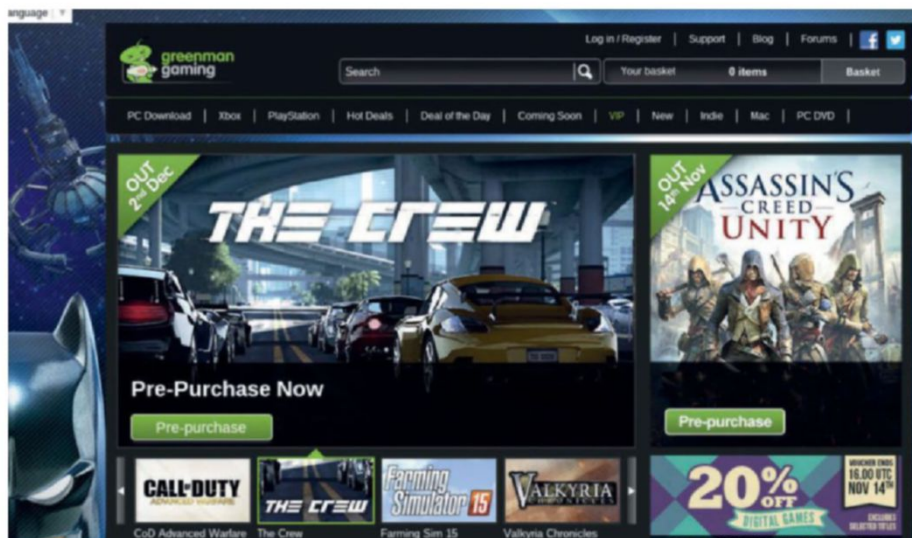
Others followed Steam's quietly revolutionary sale. The first Humble Indie Bundle, released in 2010, offered older games *World of Goo*, *Aquaria*, *Gish*, *Penumbra: Overture*, and *Lugaru HD* for whatever price purchasers wanted to pay—an idea that had its roots in the pay-what-you-want pricing of Radiohead's album *In Rainbows*. It generated over \$1 million in sales. Developers got a fair chunk of cash, and a little money went to charity, too.



Stardock Central: this is what Steam's grandad looked like.

Humble has since branched out into mobile formats and other media, such as audiobooks and digital graphic novels, and even hosts its own store. It also dropped the "indie" title for bundles from bigger companies such as THQ, EA, and Warner Bros. The EA bundle stands out as the most successful to date—it generated a massive \$7 million in revenue for the company, despite the fact you needed Origin to claim the games.

Around this time broadband connections were getting faster, and powerful graphical hardware capable of quickly decoding high definition video streams was commonplace. As a result, services such as OnLive and Gaikai were able to offer game streaming with high resolution



Green Man Gaming's unique business model has made it a great companion to Steam.



Total Annihilation offered DLC before the abbreviation even existed.

graphics and instantaneous interaction. Initially written off as little more than elaborate parlor tricks, both systems worked, with the latter being bought by Sony for adoption into its PlayStation Now streaming service.

As it stands, OnLive represents a gaming version of Internet entertainment services Spotify and Netflix. For \$9.99 a month you can access 250 games, which can be streamed to any device with a screen. The service has also expanded with its CloudLift platform, which allows you to play games on the cloud and download them to Steam. While OnLive perhaps hasn't been embraced by gamers in the way its founders expected, it's been an industry hit, with most large studios offering games via the service.

You can still wander into a store and buy a boxed copy of a PC game, although the shelf space allocated to the medium is rapidly shrinking. PC games still at times have an edge

over console versions when it comes to pricing, and that's on top of the numerous advantages of the PC being a flexible platform, and one which has shaken its bug-ridden image.

So that's pretty much the state of how the industry's working at the moment. It's just the tip of the iceberg, too—mobile titles make truckloads of cash in a triumph of quantity over quality. Vast streams of money, meanwhile, come in from licensing and spin-offs; according to publishing analyst Nielsen BookScan, *Minecraft* books alone are almost a \$4-million-a-year industry. And boxed software, predominantly released for consoles, is still the biggest revenue stream. Over in the UK industry, for example, boxed software sales were valued at \$1.5 billion in 2013, compared to digital and online game revenues of almost \$1.3 billion.

TOO BIG TO FAIL?

With such vast amounts of money coming in, it's hard to see how anything could ever go wrong. But this is a turbulent, immature industry. Since the industry began, 614 companies have been declared bankrupt; games with huge budgets and talented crews can completely flop, and for every successful console there's been a handful of out-and-out failures.

However, we haven't actually seen many of these failures for a few years. *APB* and *Kingdoms of Amalur: Reckoning* were the last major gaming flops; THQ was the last company

OVER THE WATER

UK Interactive Entertainment Association CEO Dr Jo Twist talks tax relief and piracy



MPC: The UK introduced tax relief for developers last year. Has it had an effect on the games industry yet?

JT: The tax breaks scheme officially came in on 1 April 2014, and we've been touring with our tax breaks roadshow since then to make sure all developers know about how to make their claim. The initial response has been incredibly positive. We encourage as many businesses as possible who think they might be eligible to take a look at the Cultural Test to see if they might qualify for any development costs from 1 April this year.

MPC: Does piracy still have an effect on the way the games industry works financially?

JT: The games industry has always been very good at dealing with this issue in different ways to other sectors. Games deal with it through diversity of business models, having the best relationship with its community of fans and potential fans, as well as giving access to games when players want it. It's still an issue for PC games in particular, but it's interesting to see how models such as Early Access can change the landscape.

MPC: The games industry is becoming more and more lucrative every year. Is there any danger that it'll completely crash?

JT: As an industry we keep going from strength to strength—but the data on digital sales, compared to boxed sales, is still not consistent and public enough, which doesn't help us tell our story as a sector. On a yearly basis, games beat music and film sales, and we are growing even faster as a sector globally. We are in the era of content creators, and barriers to entry have never been lower. Games are at the forefront of innovation and creativity and we are the blueprint for a creative digital economy, but we must learn to be agile and flex in order to remain as such.



Bioshock's price was slashed to just \$4.99 for the first Steam sale in 2009.

to go bankrupt. While it's great that no-one's lost their livelihoods for a while, and that games seem pretty much guaranteed to make their investments back, this can lead to one of the worst things for any industry: overconfidence.

HIGH STAKES

Every major stock market disaster, from the 1929 Wall Street Crash to the 2008 financial crisis has come about, in part, due to overconfident investing. If investors believe they're putting money into a sure thing, this can lead to a rapid growth in credit and loans, and suddenly publishers are treating \$100 million games like \$10 million ones. Games require more investment than ever before, with *Star Wars: The Old Republic* rumored to have cost more than \$500 million to produce.

The stakes, therefore, are a great deal higher. If just one game fails, it can drag a whole developer or publisher down with it—as happened with *Kingdoms of Amalur's* creators Big

Huge Games and 38 Studios in 2012. A bigger studio, such as Activision Blizzard, could be brought to its knees if *Overwatch* flops.

The industry has certainly learned its lesson thanks to the sheer number of consoles on the market leading up to the crash of the 1980s; the last console to be considered a failure was Sega's Dreamcast, but Sega cannily repositioned itself as a software company. The final piece of the puzzle is the games themselves. Afraid to take risks with massive investments, publishing companies are tending to play it safe with sequels and spin-offs. The problem here is that gamers will be put off if identikit titles are released year after year.

The elements for another crash are there, even if the industry is too varied and too huge to ever fail as catastrophically as it did in the early 1980s. But nothing is permanent. Maybe 30 years from now, hundreds of thousands of Steam keys will be found buried in the New Mexico desert... ☹



World of Goo was part of the first pay-what-you-want Humble Indie Bundle.



PLAY IT ALL. ANY GAME, ANY TIME, ANYWHERE



Starting **\$599**

Learn more at www.sybergaming.com



Intel® Core™ i7 Processor



Intel® is not responsible for and has not verified any statements or computer system product-specific claims contained herein. Intel and the Intel logo are trademarks of Intel Corporation in the U.S. and/or other countries.



www.sybergaming.com
888-937-5580
730 Baldwin Park Blvd
City of Industry, CA 91746



ts: **AUTOPSY**

THIS MONTH WE DISSECT...

Google Nexus 9



Prepare to deal with adhesive as strong as you're likely to find in a tablet.



At 6,700mAh, the glued-on battery is squarely between the iPad Air 2 and iPad Mini Retina Display.



About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

BACKGROUND:

A commodity-spec Android tablet for the mouth-breathing masses? Yuck. But wait. It packs one of Nvidia's smart-ass new Tegra K1 chips, the version with Nvidia's special-sauce Denver cores. Intriguingly, the Denver variant has just two cores compared to the quad-core version that's based on ARM A15 CPU cores. So that's two K1s with different core counts and architectures. Baffling and fascinating? You betcha.

MAJOR TECH SPECS:

- 8.9-inch IPS LCD with a resolution of 2048x1536
- 64-bit Nvidia Tegra K1 dual-core processor running at 2.3GHz, paired with a 192-core Kepler GPU
- 2GB RAM
- 8MP f/2.4 rear-facing camera + 1.6MP front-facing camera
- 802.11ac 2x2 (MIMO) Wi-Fi, Bluetooth 4.1, NFC
- 16 or 32GB on-board storage
- Android 5.0 Lollipop

KEY FINDINGS:

- The Nexus 9 is marketed by Google, but it's an HTC-built tablet (no doubt with design input from the former). Anyway, the rear cover is held on with clips, not fierce adhesive. Huzzah! No tools are needed to pop it off, just sturdy fingernails. This is where the disassembly good news ends.
- We scan for additional things to shake our spudger at. A bit of gumshoeing turns up what appears to be the NFC antenna. Our teardown fingers peel it apart from the rear case.
- The battery is within our reach, but not our grasp: some fairly heavy-duty adhesive holds it fast in place. Fortunately, we're equipped. A quick visual inspection verifies Google's official specs, with a rating of 3.8V, 6,700mAh, and 25.46Wh.
- Prominent chips include some Elpida/Micron Technology RAM (2GB), 16Gb of Samsung NAND Flash, a Broadcom 5G Wi-Fi 802.11ac/Bluetooth 4.0/FM Module, [deep breath] and a Broadcom Integrated Multi-Constellation GNSS Receiver.
- Can we separate the LCD from the display assembly? Yes. But it requires an insane amount of heat, patience, and prying. This is some of the toughest adhesive we've ever met in a tablet—on par with the infamous Surface Pro.
- Nexus 9 Repairability: 3 out of 10 [10 is easiest to repair]. The rear case can be easily removed without heat or tools (just don't lose your rear-facing camera). The battery is easy to get to, but glued in place. Thankfully, heat isn't required. Inside is a maze of tape and thin cables, making disassembly and reassembly difficult and perilous. The LCD is fused to the front glass, so you'll need to replace both components if your screen is cracked. Finally, the display glass is insanely and solidly glued to the midframe, making the replacement difficult unless you can source the whole assembly.

MAXIMUM PC AT ITS BEST ANYTIME, ANYWHERE!

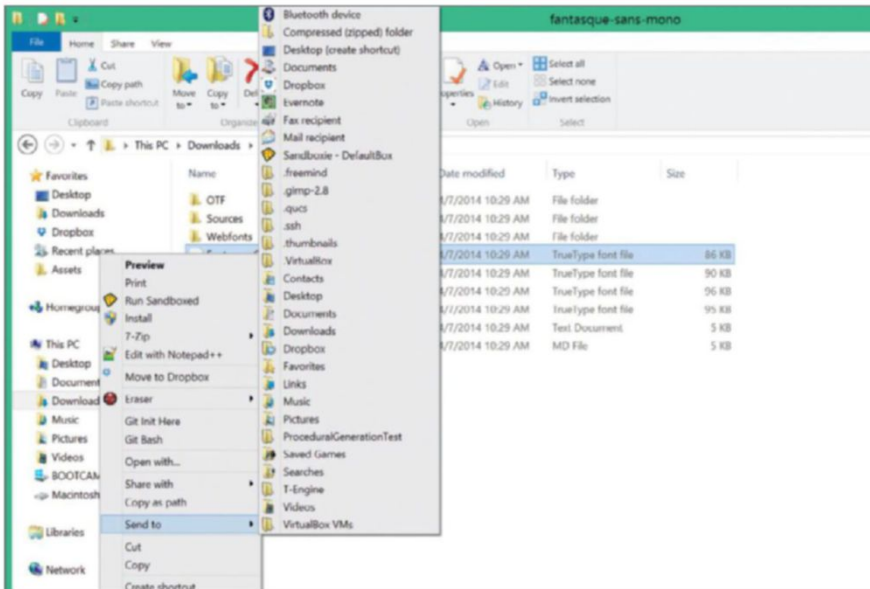


Print or Digital subscriptions available!
www.maximumpc.com/anywhere

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH



ALEX CASTLE
CONTRIBUTING EDITOR

DON'T OVERLOOK AMAZON WEB SERVICES

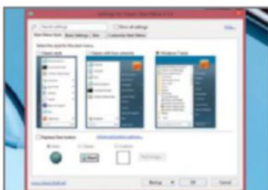
Generally, there's a pretty big gulf between business-oriented software and services, and those marketed to consumers. The former tends to cost a lot more, and to be impractical for small-scale usage. But recently I've used Amazon Web Services for a few online projects, and I've noticed it bucks this trend. It's marketed mostly to web developers, but it's got a lot to offer PC power users as well.

There's one service offered by Amazon that's worth looking into for your personal cloud solution. It's called Glacier, a cloud storage service that specializes in long-term storage of bulk data. Its bargain-basement pricing of 1 cent per gigabyte per month is hard to beat, though you get charged extra if you need to retrieve a lot of your data at once, so it's designed for long-term archiving. It's not for the same sort of daily-use syncing as Dropbox, and it's nowhere near as user-friendly, but if you're a data hoarder this might be the most economical archiving service for you.

SUPERCARGE "SEND TO"

You've probably noticed the handy "Send to" option in the File Explorer's right-click context menu, which lets you move a file directly to a number of common directories. But did you know you can supersize the list of possible destinations? Just hold Shift while right-clicking, and you'll see a much larger list of send to locations.

MAKE – USE – CREATE



62
Customize
Windows 8.1



65
Fix your ultra-
widescreen woes

submit your How To project idea to: comments@maximumpc.com

Customize Windows 8.1

YOU'LL NEED THIS

CLASSIC SHELL

Head to www.classicshell.net for a new custom Start menu.

STARTISBACK+

Does what you'd expect. Get it from <http://bit.ly/1eDnJ2h>. To run it, you'll need Chocolatey. Find it at <http://bit.ly/qbvEmi>.

POKKI

Also restores the Start menu (<http://bit.ly/1f9GKI0>).

THE WINDOWS 8.1 INTERFACE is the latest iteration of the Windows desktop, but you don't have to stick with the default look. The Modern UI was a radical change, and many people still expect the Windows Start button to bring up a classic Start menu rather than the new Start Screen (and get frustrated when it doesn't). But with a few tweaks, that core interface element can be returned. We'll look at three different versions you can install for free.

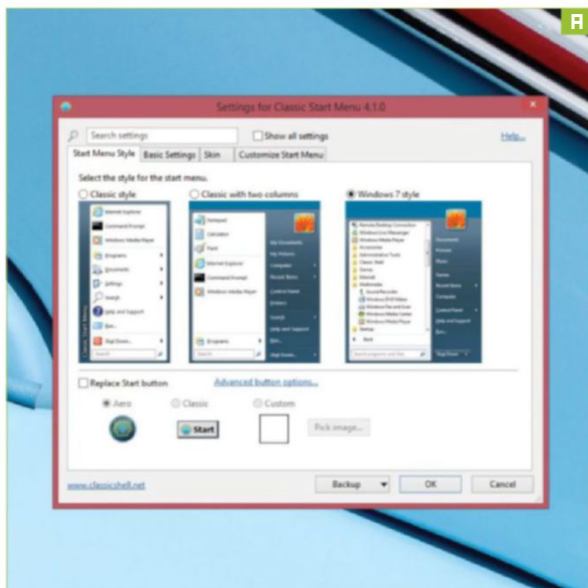
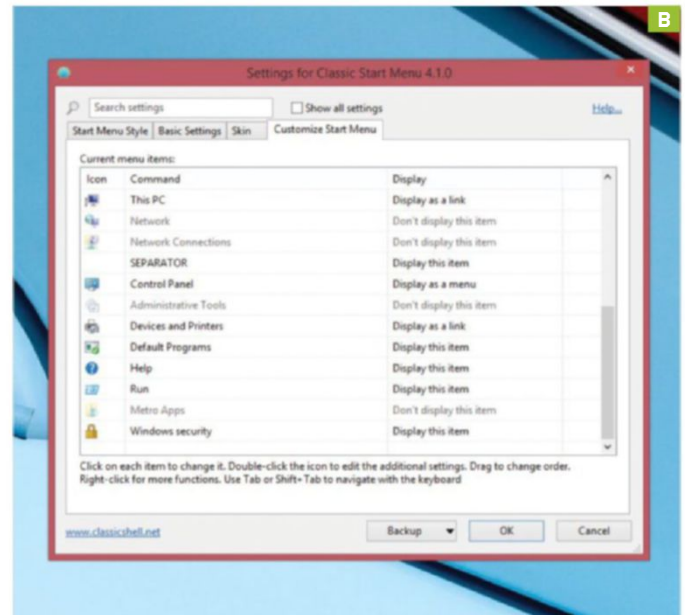
Plus, there are more ways to improve the OS. For example, the slimmed-down desktop means it isn't always obvious where to go for the options to change the interface, but main ones can be found by right-clicking the Taskbar and clicking Properties. Another thing that might annoy you is Microsoft's decision to disable the Libraries feature by default, but this can be reinstated by opening "Windows Explorer → View → Options" and ticking "Show libraries." Read on for more handy tips. —CHRISTIAN HALL

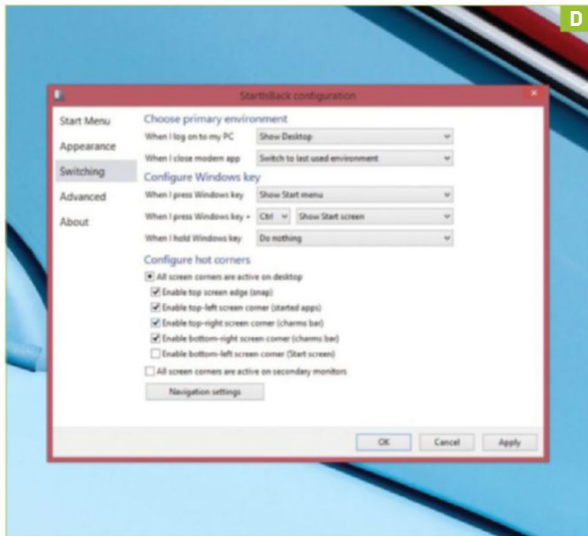
GET THE START MENU BACK AND CUSTOMIZE IT

Various third-party programs will bring back the classic Windows Start menu in Windows 8. One of the most popular is Classic Shell (free at www.classicshell.net). This gives you three different styles for the Start menu (Image A), options for the Start button, and skin choices to make it fit naturally into Win8 (such as reducing transparency and changing icon size).

» You can right-click on the Start button and select "Settings" to bring up the Classic Shell options at any point (Image B). You've already chosen a style for your new Start menu, so click "Customize Start Menu" to choose which menu items you want included. Beside each program in the list, choose either "Don't display," "Display as a link," or "Display as a menu" to suit the way you work.

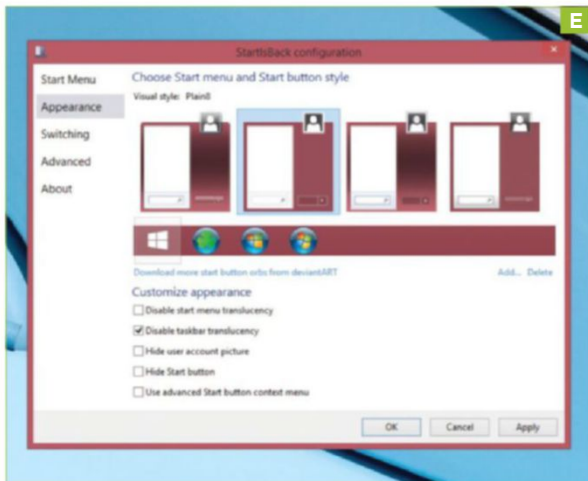
» Another option is StartIsBack+ (Image C). Before you can begin, install the PowerShell execution engine, Chocolatey, from <http://bit.ly/qbvEmi>. Once that's done, download the StartIsBack+ installer package from <http://bit.ly/1eDnJ2h>. You can't execute this file—instead, you must go into the Command Prompt and type "cinst startisbackplus," then hit Enter.





2 SWITCHING OPTIONS

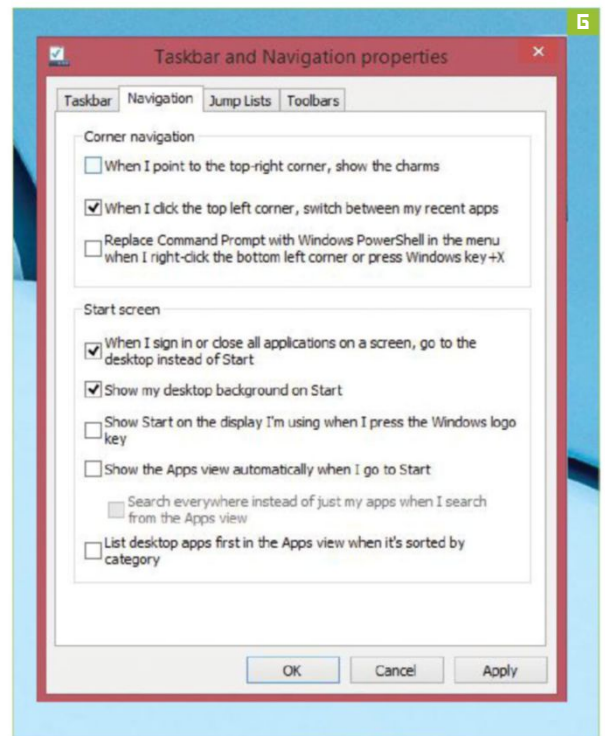
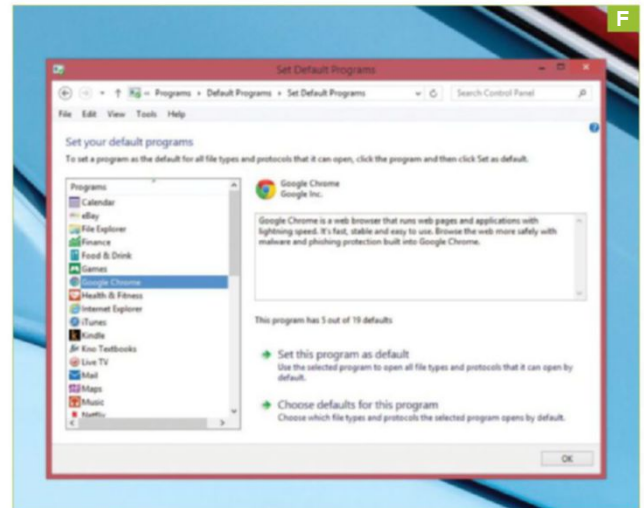
Now restart Windows. Under the “Switching” tab you can specify what your PC should do when you boot into Windows 8 (Image D), and configure the Windows key to perform a certain action in the interface. You can also configure hot corners from this menu—a feature missing from Windows 8.1 as standard. All of this means you can change the default interface settings to better suit your needs.



3 CHANGE THE START BUTTON

You can also make some visual alterations with StartBack+ under the “Appearance” tab (Image E). For instance, you can get the old Windows 7 Start orb back, instead of the new white Windows logo. There’s also a link here to DeviantART, where you’ll find custom Start buttons that you can download and install. You can select new visual styles for the whole Start menu, too.

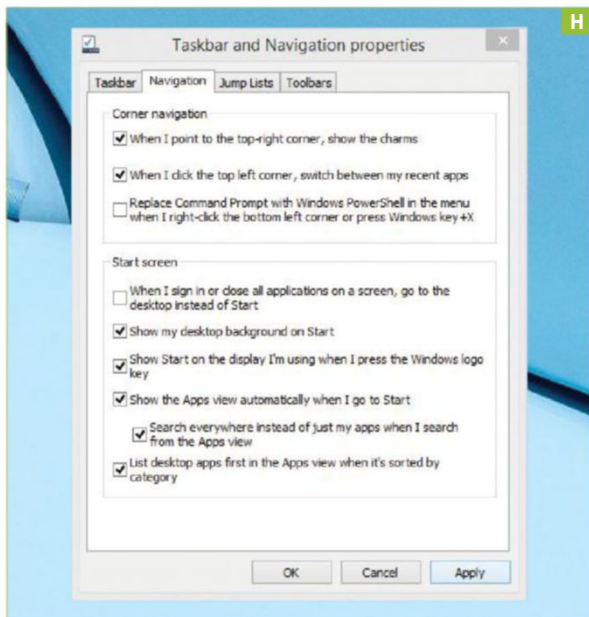
» Windows 8 Start Menu by Pokki (download it free from www.pokki.com/windows-8-start-menu) is another great tool, but it doesn’t actually replace the Start button. With Pokki, you can search and organize your favorite apps and websites on your desktop, just like you would on a smartphone.



4 ESCAPE THE MODERN INTERFACE

Music, videos, pictures, and PDFs are automatically opened using Modern UI apps by default, but you can change this behavior so they open within the desktop instead. From the Start screen, type default programs and click on the “Default programs” icon under the results. Click “Set your default programs” and choose the app you want to set as your default for each file type (Image F).

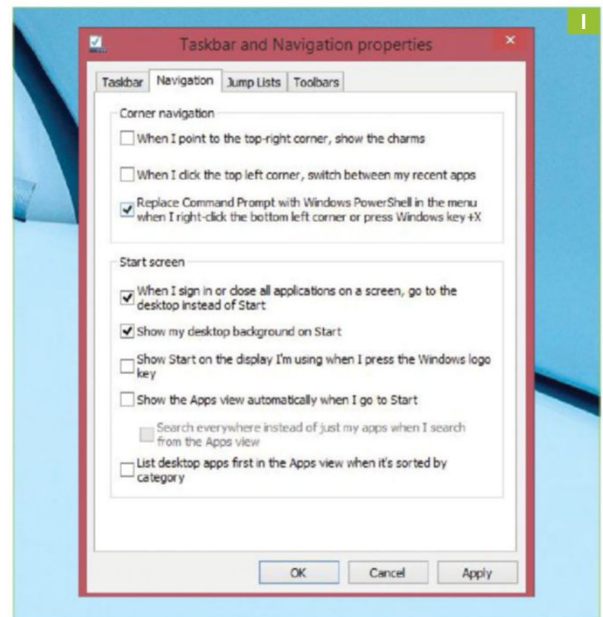
» While you’re at it, disable the Charms as well. Charms in Windows 8.1 are designed to speed up access to menus, but they’re activated by the hot corners, which can be a nuisance. If you find yourself inadvertently activating the menu with your mouse whenever you move the pointer to the top-right, it’s possible to disable it. Go to “Taskbar → Properties → Navigation” and untick “When I point to the top-right corner, show the Charms” (Image G).



H

5 SHOW ALL APPS

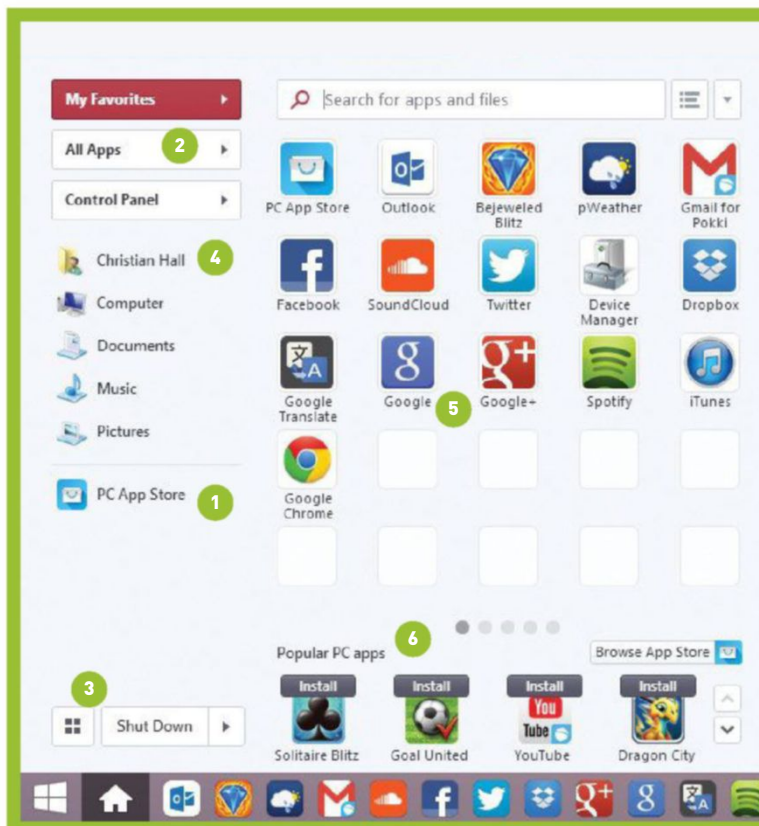
If you want to retain the Modern Start Screen but are keen to change the layout, it's possible to display all of your installed apps at once. Right-click on the Taskbar and choose "Properties → Navigation." Tick the last four boxes in the Taskbar and Navigation Properties dialog box (Image H). When you click on the Start button, you'll see all of your desktop applications first on the list.



I

6 REPLACE THE COMMAND PROMPT

Right-clicking on the Windows button brings up a list of power user commands. If you want to perform complex tasks that use DOS-style commands, you can replace Command Prompt with Windows PowerShell. To give this a try, again, right-click on the Taskbar and choose "Properties → Navigation" and tick "Replace Command Prompt with Windows PowerShell" (Image I).



POKKI POWER

1. PC APP STORE

Click here to install new Pokki apps through the store. Alternatively, you can use the search bar in the top-right of the Pokki menu.

2. ALL APPS

Gives you a list view of all your installed apps. Add them to your Favorites by clicking the star icon on the right.

3. TOGGLE START MENU

This button toggles between Pokki's Windows 8 Start menu and the Modern UI. Pokki's tool doesn't replace the Modern UI like some programs do.

4. YOUR FOLDERS

If you liked the way the traditional Start menu worked, with quick links to your folders, this is where they are in Pokki.

5. MY FAVORITES

Pokki groups your favorite apps like a smartphone home screen, making it faster to launch programs.

6. POPULAR PC APPS

Pokki's recommended apps appear here. These are an unpersonalized selection of popular installs.

Fix Your Ultra-Widescreen Woes

YOU'LL NEED THIS

FLAWLESS WIDESCREEN

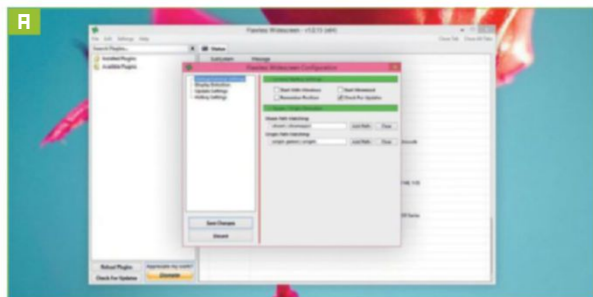
Pick up the program at

www.flawlesswidescreen.org.

WHEN THE FIRST 29-inch ultra-widescreen monitors arrived, we loved their potential but decried their use on the standard Windows desktop due to the lack of vertical height. But LG and AOC have launched 34-inch monitors with 3440x1440 native resolutions, so we're back on board. They're still niche displays though, and many games don't support them out of the box. You either get black bars down the sides or stretched images. Luckily, a programmer created Flawless Widescreen—it's very easy to use, and can source game locations from both Steam and Origin. —DAVE JAMES

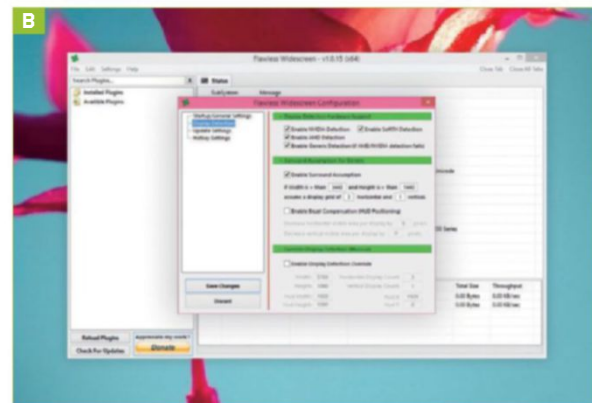
1 DRIVER TIME

Before you get started, ensure your graphics drivers are up to date. Go to your card manufacturer's website and download the current version. Now download the Flawless Widescreen app at www.flawlesswidescreen.org. Once it's installed, a shortcut will appear on your desktop. Launch it and you'll be asked if you want to change the settings (hint—you do). First check your game locations (Image A). Steam and Origin locales are in place by default. You can also add new ones.



2 ARE YOU SURROUNDED?

The next step is to sort out the software's Display Detection. By default it's set up to target surround visuals with grouped monitors, but if you rock a single 21:9 screen, that can lead to distortion at the edges. Under the Surround Assumption section (Image B), enter the resolution of your current screen to prevent the program treating your screen as though it's a wrap-around display array.



3 PLUG IT IN

In Update Settings you can arrange how to keep your game plugins up to date. The standard setting lets you choose which specific plugins to install, but it can install them automatically if you want. On the left-hand side of the display you'll see the available game plugins (Image C). The specific titles known to have widescreen problems are likely to be available, and new ones are added regularly. Simply double-click on the plugin for your chosen game to install it.



4 MR FIX IT

Once you've got your plugin installed, make sure the "Fix enabled" checkbox is ticked. The fix is in, so now is the time to start up the game and check to see if the plugin is working for your display (Image D). Flawless Widescreen offers little tweaks if you're not satisfied with how things have worked out post-fix. Experiment with the FOV slider and individual fixes to adjust how your game looks.



BUILD IT

TOM MCNAMARA TECHNICAL EDITOR



The Anatomy of a Powerhouse

So an eight-core Intel CPU, three video cards, and a new Samsung SSD walk into a bar...

LENGTH OF TIME: 2-4 HOURS LEVEL OF DIFFICULTY: MEDIUM

THE MISSION

OVER THE COURSE OF A YEAR, hardware comes into the *Maximum PC* lair in trickles and deluges. We also end up stockpiling things we don't have an ideal use for. This month, a convergence of timing and opportunity leads us to this point: something kind of ridiculous, but also very good-looking and beefy. In other words, perfect *Maximum PC* material. We try to do different kinds of systems for a variety of budgets, but sometimes it's just more entertaining to put dollar signs aside and assemble the craziest Voltron we have the parts for.

One piece of gear—the CPU cooler—is new enough to us that we haven't reviewed it before, while the Samsung 850 EVO SSD is fresh in the lab. In fact, the drive was still under NDA (non-disclosure agreement) as we were putting this system together. That means we might have gotten in trouble if we'd even publicly confirmed its existence. Now we can pull back the curtains.



IF YOU BUILD IT, THEY WILL COME

WE'VE BEEN MEANING to put the Corsair 760T full-tower case to use for some time. We've had it long enough that Corsair has produced the 780T as an evolution of it (we'll be getting our grubby hands on that one soon). This build will make ample use of a full-tower's dimensions, and the 760T has generous options for airflow. We've done two 980 video cards already, but not three. Powering them is a monster 1,600-watt EVGA power supply we've repurposed from the Dream Machine. It's a lot more juice than this system will ever need, even if we were to add a fourth GTX 980 and overclock everything to the hilt. But it seemed a shame for such fine equipment to go unused.

We've built for an eight-core Intel Haswell-E CPU before, but not actually used the full-blown eight-core job. We used 6TB hard drives in the Dream Machine, but not in a real-world build. And this is the first time we've wrangled the Cooler Master Nepton 240M CPU cooler and the Samsung 850 EVO SSD. We also have a motherboard from ASRock, which doesn't get a lot of representation at the premium tier. There's also 32GB of Corsair Dominator DDR4 RAM in the mix. But if this all sounds complicated, it's really more like LEGO parts than rocket science. The most time-consuming element is just giving the system a clean look after putting this much gear inside.

INGREDIENTS

PART		PRICE
Case	Corsair Graphite Series 760T	\$159
PSU	EVGA SuperNOVA 1600 G2	\$320
Mobo	ASRock X99 OC Formula	\$290
CPU	Intel Core i7-5960X	\$1,000
GPU	3x Nvidia GeForce GTX 980	\$1,650
SLI Bridge	EVGA Pro SLI Bridge (3-way/2-way)	\$30
RAM	4x 8GB Corsair Dominator Platinum DDR4	\$800
HDD	6TB HGST Ultrastar He6	\$700
SSD	250GB Samsung 850 EVO	\$200 (est.)
Cable Kit	EVGA G2/P2 PSU Cable Set	\$90
OS	Windows 8.1 64-bit OEM	\$100
Total		\$5,339

1 YOU CAN ONLY HOPE TO CONTAIN IT

LIKE THE CORSAIR Obsidian 750D, the 760T has a magnetized cover on the top of the case. This time, it's hard plastic instead of a mesh. Since we're exhausting air and not pulling it in, the lower airflow isn't a big deal, and this style is a bit cooler-looking. The top of the 760T takes 280mm and 360mm radiators, as well. If you're into serious overclocking, then a CPU the size of the Core i7-5960X would benefit from larger rads.

As its name implies, our Nepton 240M cooler uses a 240mm rad, which is fine for less ambitious octo-core overclocking. However, if you want to install your fans on the underside of the rad, the 760T uses rubber grommets for which the Nepton's mounting screws are too short. You can get a variety of machine screws at your local hardware store.



2 BECOMING UNHINGED

THIS NEXT SHOT demonstrates a couple of interesting properties. The main one is the 760T's side panel. It's actually a swing-out door with a levered handle, like on the Thermaltake Level 10 GT. When it's rotated this far out, you can lift it off its hinge and set it aside. No screws to deal with. We've also removed one 3.5-inch drive cage and mounted the other one right below the 5.25 drive bay. We did that mostly just to see what it looks like, but also to help visualize the placement of custom water cooling gear like reservoirs and pumps. Our SSD is secretly mounted behind the drive cage, on the same plane as the motherboard.



3

DOWN UNDER

LOOKING AT THE UNDERSIDE of the case, we have a set of six screws holding down the two drive cages. Two screws hold down the cage that's closest to the front of the case. It feels secure despite being half as many as we'd like, and you don't need to remove the case's front foot to access the screws holding down the cage. Removing the four-screw cage reveals a 120mm fan mount. This is ideal for intake, but you'll have to keep an eye on dust or add your own filter. To the right of that is the intake for the power supply, which comes with a slide-out filter.



5

BUILDING BRIDGES

ONE OF THE FUN THINGS about building with Nvidia cards is their SLI bridges. This fancy job comes courtesy of EVGA, and its design matches that of our cards, which use the "reference" design of the base model. At 30 bucks, the bridge is not cheap. But when this machine is powered on, the logo lights up green to match the lighting of the letters on the cards. The top section of the bridge is just barely short enough to wedge in underneath the case's pre-installed 140mm exhaust fan. It's one of the tightest clearances we've dealt with. You can flip it around and get a lot more space, but then the Nvidia logo is upside-down, which irks us. To get the GTX 980s installed this close together, by the way, you need to unscrew a raised plate near the cable connectors on the other end.



4

GETTING IN MY GRILL

THE FRONT OF THE CASE has two 140mm fans pre-installed. The blades are made of clear plastic, presumably to let custom lighting shine through better. The case comes with a two-speed fan controller pre-installed, but we chose to skip it when wiring things up, in favor of testing the fan headers on the motherboard. We'd recommend a fan cable extension or two, because the cables on the front fans are not especially long. In contrast to the 750D, the fan grill on the 760T can be removed completely, making for easier access. In both cases, the grill snaps in and out easily. No screws or yanking required. If you remove the other 3.5 drive cage (or mount it over the 120mm fan on the bottom of the case) you could squeeze in a 240mm radiator, if you wanted. The 780T has even more room up front, enough to comfortably accommodate a 280mm radiator.



6

TANGLES AND DANGLES

WITH THREE VIDEO CARDS, five fans, and two storage devices, there's a lot of cabling. We switched to the kit of individually sleeved cables to lend some flexibility, but we'd *have liked to have made* more adjustments, if we'd had time. The case comes with four 2.5-inch trays, but we removed all but one to make room. Since we didn't wire up the fan controller, we fed its cables back, tucking them into the empty 5.25-inch drive bay. The 8-pin PCI Express cables have two of their six pins on a separate cable, so we snaked the spares up with the fan controller cables. (The reference GTX 980 needs only 6-pin cables.) The cable connecting the front USB 2.0 ports to the mobo was just long enough to reach. You can buy extension cables online.





1. The heatpipes on the mobo's heatsinks boost the heat the voltage regulators can handle, which helps with overlocks.

2. There's enough clearance above the motherboard to fit a 38mm radiator, rather than the standard 25mm kind.

3. Like Intel's X79 motherboards, the X99 version has eight RAM slots and can take up to 128GB of DDR4 (but no DDR3).

4. This power supply has so many plugs to choose from that we can connect all of these while leaving enough space to install a fan below.

THE THREE MUSKETEERS

ONE OF THE ADVANTAGES of working with an X79 or X99 system is its support of more than 16 PCIe lanes. The i7-5960X can wrangle a whopping 40 lanes, in fact. For a pair of high-end video cards, 16 lanes is enough, but just. With the rise of 4K, extra lanes are welcome. Even the best GPUs need to whip out the buddy system to handle a resolution that high.

With the GTX 980s, our gaming performance was 10–20 percent better than the system we assembled for the May 2014 issue that had three GTX 780s and a hex-core i7-4960K. This month's system averaged 110fps in *Tomb Raider*, at 4K, with everything but antialiasing enabled, while the other system didn't hit 100. *Hitman: Absolution* also recognized all three cards, so we averaged about 100fps there.

The case's dimensions are also handy when wrangling this much hardware. Despite these cards being over 10-inches long, we didn't need to remove any drive cages to fit them in. And despite all that cabling, there's plenty of space behind the motherboard. Sometimes, after you're done hooking up, you need to basically squish the side panel down until you can secure it. Here, we needed only a gentle push.

Now, the i7-5960X has a base clock of 3GHz, so we're never going to hit 5GHz like we did with X79. But because of Haswell's higher performance, plus the extra cores, multithreaded performance is hugely better. We got this rig up to 4GHz, very respectable for a 240mm closed-loop liquid cooler juggling up to 16 CPU threads. When those are all fully engaged, this

chip will trounce 12-thread CPUs that reach 5GHz. For pure gaming, an i7-5960X is a poor choice, but highly threaded tasks like video encoding feast on power like this. Ultimately, we'd recommend a custom cooling loop to get the most out of eight cores. You'd probably want a roomier SSD, too. We used the 850 EVO because it's new and interesting. 

BENCHMARKS

	ZERO-POINT	
Premiere Pro CS6 (sec)	2,000	1,288
Stitch.Efx 2.0 (sec)	831	768
ProShow Producer 5.0 (sec)	1,446	1,504 -4%
x264 HD 5.0 (fps)	21.1	33.8
Batman: Arkham City (fps)	76	213 280%
3DMark 11	5,847	14,354

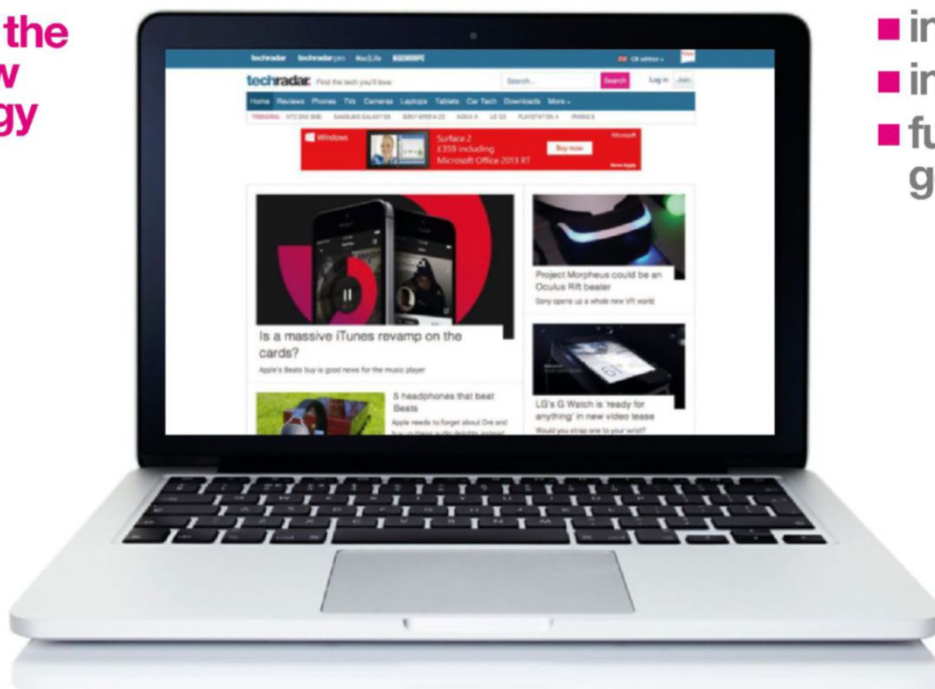
0% 25% 50% 75% 100% 125% 150% 175% 200% 225% 250%

The zero-point machine compared here consists of a 3.2GHz Core i7-3930K and 16GB of Corsair DDR3/1600 on an Asus Sabertooth X79 motherboard. It has a GeForce GTX 690, a Corsair Neutron GTX SSD, and 64-bit Windows 7 Professional.

Introducing a global tech brand
that promises to change the way
you consume technology

techradar.

Covering the
latest new
technology



- in depth
- in detail
- fully tested gear

REVIEWS

TESTED. REVIEWED. VERDICTIZED.



INSIDE

- 72 Zotac GeForce GTX 970
Amp Extreme Edition
- 74 Samsung 850 EVO SSD
- 76 Gigabyte P35X V3
- 78 OCZ ARC 100 240GB
- 80 Scythe Mugen Max
- 83 Crucial Ballistix Sport 16GB
DDR4
- 84 Microsoft Universal
Mobile Keyboard
- 86 Far Cry 4
- 88 Assassin's Creed Unity
- 90 Call of Duty:
Advanced Warfare
- 92 Lab Notes

ZOTAC
GEFORCE
GTX 970 AMP
EXTREME
EDITION
PAGE 72

Zotac GeForce GTX 970 Amp Extreme Edition

Feet firmly planted in Serious Business territory



With its curving lines and faux carbon fiber, the Amp Extreme looks more like a street racer than a video card.

NVIDIA'S NEW MAXWELL GENERATION of video cards breaks down into two categories: the GTX 970 and GTX 980. As its numbering implies, the 970 is the less-expensive and not-as-fast option, coming in at around \$330 for the basic model. As you can see from the photo, Zotac's Amp Extreme Edition is anything but basic, with an appropriately higher street price of about \$400. What does that extra cheddar get you?

Aside from performance that can pretty much guarantee 60fps at 1080p, the Amp Extreme (one tier above Zotac's "Omega") gets you some massive cooling. Since the GTX 970 is only rated to need 145 watts before overclocking, it's not putting out a lot of heat, by video card standards. With this jumbo-sized heatsink helping things along, the trio of fans never has to work that hard, so the result is a very quiet piece of hardware, no matter how hard you push it.

The Amp Extreme already has an aggressive overclock before you plug it in; the GPU core clock is pushed from 1,050MHz to 1,203MHz, which pushes the "boost" clock from 1,178MHz to 1,355MHz. The 4GB of GDDR5 RAM on the card is also overclocked from 7,000MHz to 7,200MHz. If that seems a lot, we were able to push things even further, to a core clock of 1,400MHz and a memory clock of 8,000MHz. Even this far above its factory specifications, the GPU never got above 70 C during our tests.

The actual rise in performance is not linear, since your GPU still depends on other parts of the computer to keep up. But this is a hefty amount of headroom made possible by Zotac's considerable cooling design, and by some adjustments it's made to the circuitry of the card underneath.

CORE PERFORMANCE

Despite all of this added beef, though, the Extreme Edition still can't quite reach the performance of the basic GTX 980. This is largely due to the 970 having 1,664 shader cores, while the 980 has 2,048. (This is still much lower than the older GTX 780, but performance per core is much higher with the newer cards.) Still, it gets quite close for about \$150 less (which means about \$200 for less fancy models). So, as this issue went to press, 970s were in short sup-

ply no matter what their price. Meanwhile, AMD slashed the price of its comparable Radeon R9 290 and 290X cards, and you can now find them for as little as \$250 and \$300, respectively. These two cards have TDPs ranging from 250 to 300 watts, though, so you can't add a second one unless you have a beefy power supply. The bottom line is there's an aggressive price war going on, and the price points will probably have evolved further by the time you read this. Another factor is the game bundles, which also change frequently.

At any rate, with a card the size of the Amp Extreme, you have to make compromises. It's 12-inches long and 2.5 card slots wide. It won't fit in some smaller cases, and some mobos don't have their PCIe slots spaced far enough apart to accommodate this card's huge heatsink, in which case adding a second card for SLI is off the table. This Extreme Edition also requires two 8-pin PCIe power cables (the base model uses two 6-pin cables), but that's pretty common these days, as long as your power supply is rated for at least 500 watts.

If you're firmly on the Nvidia side, then the Amp Extreme is a tempting piece of gear. If you have no affiliation, the Radeon R9 290 is arguably better value, at least versus the \$400 version of the GTX 970. The 290 isn't as fast, but it can be a lot cheaper if you shop around. For pure performance regardless of cost, the GTX 980 is still your best bet.

—TOM MCNAMARA

SPECIFICATIONS

Interface	16x PCIe 3.0
Cores	1,664
Core Clock	1,203MHz (base); 1,355MHz (boost)
Memory Clock	7,200MHz
Memory Type	GDDR5
Memory Size	4GB
Ports	1x DVI; 1x HDMI; 3x DisplayPort; VGA



**Zotac GeForce GTX 970
Amp Extreme Edition**

■ **BRATWURST** High performance; minimal noise; pleasing aesthetics.

■ **VEGGIE DOG** Relatively expensive; a little on the husky side.

\$400 (street), www.zotac.com

BENCHMARKS

	Zotac GeForce GTX 970 Amp Extreme	MSI GeForce GTX 980 Gaming 4G	Asus ROG Matrix Radeon R9 290X	Sapphire R9 290 Vapor-X OC	Gigabyte GTX 780 GHz Edition
Tomb Raider (fps)	30	35	26	25	25
Metro: Last Light (fps)	44	53	30	29	25
Batman: Arkham Origins (fps)	68	80	65	62	71
Hitman: Absolution	38	43	51	49	45
Unigine Valley 1.0 (fps)	39	47	41	39	48
Unigine Heaven 4.0 (fps)	34	42	33	34	39
3D Mark Fire Strike	10,143	11,480	9,837	9,602	9,695
Price (street)	\$400	\$570	\$430	\$315	discontinued

Best scores are bolded. Our test bed is a 3.33GHz Core i7-3960X Extreme Edition in an Asus Rampage IV Extreme motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8.1. All games are run at 2560x1600, except for 3DMark.

Fancy new 3D NAND, old school SATA connectivity



The new EVO's biggest improvement is write speeds, beating the old 840 by around 20-30 percent.

HERE WE GO. The very first solid-state drive with 3D NAND memory to hit our lab. So is it a revolution in storage or the same old 6Gb/s SATA stagnation with a fancy name?

The new 3D V-NAND—Samsung is calling it vertical NAND—is designed to enable higher capacity SSDs. The literal idea of stacked memory is to pile NAND chips on top of each other, with through-silicon vias (TSV) providing connections directly through the stack. This helps boost bandwidth, as the connections are physically closer, but also means higher capacity drives can be made without relying on ever-shrinking NAND modules.

Samsung's second-gen 3D V-NAND is made up of a full 32 layers stacked atop each other, each module offering a total density of 86Gb. Now, that's not the highest density NAND you'll find in today's drives—both Crucial and Intel are throwing out drives with 128Gb density NAND—but the difference is Samsung is using old school 40nm silicon to get there.

Because of the shrinking of production processes in all spheres of computing, we've become used to seeing 19nm and even 16nm NAND in our SSDs. But because of 3D V-NAND's ability to hit these high densities with such chunky lithography, combined with the bandwidth boosts of the TSVs inside the stacked modules, the larger dies don't spoil performance.

The efficiency gains from previous production shrinks are largely offset by the power reductions in the switch from 2D to 3D NAND, too. Samsung estimates a 30

percent reduction in operational power with the Samsung 850 EVO compared with the older Samsung 840 EVO.

The 40nm process also delivers better endurance. Memory cells that wear out more quickly with repeated data writes are simply part of the landscape with finer production processes. What's more, triple-level cells make matters worse. When you're making the switch, as Samsung is, from the 2-bit multi-layer cell (MLC) design of its higher-end 850 Pro to the less-robust 3-bit triple-level cell (TLC), any endurance boost is welcome.

Anyway, the 850 EVO sports a five-year warranty. Not as hefty as the 10-year cover the 850 Pro gets. But still usefully longer than the rest of the affordable SSD world with their three-year hedged bets.

CLOSE, BUT NO CIGAR

But what of performance? This is where we're in a bit of a holding pattern. The SATA 6Gb/s interface throws up a hard 600MB/s speed limit. The solution to this is the M.2 PCIe-based interface, which offers a bonanza of bandwidth. But you'll need a new motherboard for that.

For now, Samsung's consumer drives are all about the ol' SATA 6Gb/s interface. The Samsung 850 EVO is definitely quicker than the older Samsung 840 EVO, but not enough to have you rushing out to upgrade. The biggest change is write performance. In sequential terms, we're talking 20 percent quicker than the 840 EVO and a full 30 percent quicker for the 4K random writes.

The 4K numbers represent the tiny, itty-bitty reads and writes that an operating system will be carrying out on a regular basis as you use your PC. They're a good indication of how responsive your PC will be running from that drive and the numbers represent decent improvements. We saw our 30GB Steam folder transfer test resolve 22 seconds quicker than the Samsung 840 EVO.

Overall, 850 EVO is the fastest mainstream, consumer-class SSD around. It's just not quick enough to make it a killer upgrade over the previous generation EVO.

—DAVE JAMES

SPECIFICATIONS

Controller	500GB
Controller	Samsung MGX
Memory Type	40nm 128Gb TLC V-NAND
Cache	512MB DDR2
Sequential Read	540MB/s
Sequential Write	520MB/s
Warranty	Five years

VERDICT



Samsung 850 EVO 500GB

TOTAL RECALL Good all-round performance; great value; five-year warranty.

RAW DEAL Not a huge leap forward; SATA performance limitations.

\$249, www.samsung.com

BENCHMARKS

	Samsung 850 EVO 500GB	Samsung 840 EVO 500GB	Crucial MX100 512GB	SanDisk Extreme Pro 512GB	Samsung 850 Pro 512GB
Sequential Read Performance (AS SSD, MB/s)	494	496	499	506	528
Sequential Read Performance (AS SSD, MB/s)	485	409	474	474	502
4K Random Read Performance (AS SSD, MB/s)	36	26	24	30	37
4K Random Write Performance (AS SSD, MB/s)	108	82	106	103	107
Real-World Performance (30GB folder copy, sec)	208	230	191	191	191

Best scores are bolded.

Gigabyte P35X v3

Rivaling desktop graphics is tough for any notebook, but in a thin 'n' light?

SPECIFICATIONS

CPU	Intel Core i7-4710HQ
GPU	GeForce GTX 980M
Memory	16GB
Storage	240GB SSD, 1TB HDD
Screen Size	15.6-inch
Native Resolution	2880x1620
Dimensions (H x D x W)	15.1 x 0.8 x 10.6-inches
Weight	5lb



There's no competition.
The GTX 980M is the king
of notebook graphics.



WHEN NVIDIA PULLED THE WRAPS OFF its GeForce GTX 980M mobile graphics chip, the Internet burst alive with much rejoicing. At last, here was a laptop GPU that could give the best desktop graphics cards a run for their money. Well, kinda.

Make no mistake, the 980 looks mega on paper. With 1,536 Maxwell-style shaders and a base clock north of 1GHz, the 980M is one hell of a GPU by any metric, including the desktop. It's so good, we built our cover feature around the notion that it made laptops truly competitive with desktops.

What it's not, however, is unique in history. To reach what's arguably the golden age of laptop gaming you have to wind the clock right back to 2005 and the GeForce Go 7800 GTX, a mobile GPU with the same number of pipes and shaders as the fastest desktop graphics of the day.

In that context, we're very slightly disappointed the 980M doesn't have all 2,048 of its shaders switched on. The 980M is based on the same GM204 chip as the desktop 980, after all.

That minor point aside, we can introduce the vehicle for this second taste of the 980M (we've also been hands on with Asus's 980M-equipped ROG G751 for our laptop versus desktop cover feature this month), Gigabyte's P35X v3. We've seen the P35 before and all of what we previously liked remains. It's impressively thin and light for such a powerful mobile gaming rig, especially given the P35 houses a quad-core Intel Core i7-4710HQ chip.

It's the quad-core CPU du jour for this kind of lappie and none the worse for it. With a base clock of 2.5GHz and a maximum Turbo speed of 3.5GHz, it has more than enough grunt to deliver on the P35's gaming core competence. That it also delivers nearly four hours of HD video playback on battery power is pretty nice, too.

SCREEN PLAY

Where this system differs from P35s passim is the screen. It's a glorious IPS panel with 2,880 by 1,620 pixels. Immediately, we're worried about overkill. After all, this is a 15-inch mobile rig; surely 1080p is plenty. And don't forget about Windows' traditional resolution scaling f-wittery. But here's the thing; the ultra-dense pixel grid doesn't just get close to making antialiasing redundant, it also means non-native resolutions look less blurry.

That's intriguing because, although the 980M makes an incredibly good fist of gaming at that ludicrous 2,880 by 1,620 pixel resolution, for truly smooth frames rates you're going to either need to play without antialiasing or drop down to 1080p.

Our one major worry is heat management. This notebook is offensively loud in-game. We also doubt how it can realistically manage its high GPU temps. The Heaven benchmark was reporting 85 C out of the box and it's not at all unusual for laptops to develop fairly chronic cooling problems over time. The P35's thinness and lightness looks great, but may end up being a long-term liability. —JEREMY LAIRD



Gigabyte P35X v3

USE THE FORCE Fantastic performance; ultra-dense pixel grid; half-decent battery life.

PAR FOR THE COURSE Loud; long-term heat management a worry.

\$2,400, www.gigabyte.com

BENCHMARKS

	Gigabyte P35X v3	GTX 970M	GTX 880M
DirectX 11 Synthetic Performance (1080p)			
Heaven 4.0 (min/avg fps)	8/ 54	8/41	7/36
DirectX 11 Gaming Performance (1080p)			
Bioshock Infinite (min/avg fps)	9/ 86	9/72	13/66
DirectX 11 Gaming Performance (1080p)			
Metro: Last Light (min/avg fps)	19/ 41	15/31	14/27

Best scores are bolded.

The ARC 100 smashes other SSDs in its price range when it comes to consistency.

SPECIFICATIONS

Capacity	240GB
Controller	OCZ Barefoot 3 M10
Memory	Toshiba 64Gb 19nm MLC
Interface	SATA 6Gb/s
Warranty	3 years



OCZ ARC 100 240GB

There's a new contender in town

THERE ARE FEW PARTS of the industry as volatile as the SSD world. Most other PC components are mature enough that the smaller players have faded away to leave only a few of the biggest still operating. In graphics there are three players, and in processor terms only two. With SSDs we're starting to see Crucial and Samsung pull away, but the market is still young enough to mean many hopefuls remain.

OCZ was among that following crowd. But since being bought by Toshiba, it's discovered a brighter future. After all, a big reason Crucial and Samsung have developed a lead is because they both have direct access to the pricey part of SSDs—the NAND flash. Crucial's parent company, Micron, is one of the biggest NAND producers around, while Samsung has a fair amount to call on, too. That means both can grab memory without the hefty premium.

Now Toshiba, with its own advanced NAND, is on OCZ's side and its prices are tumbling. Its latest ARC 100 is OCZ's bona fide budget offering and, at an impressive \$100, it's going right up against Crucial's MX100 range. But it's not just about pricing—the ARC 100 has also got some serious performance to back it up.

WELCOME TO THE BIG LEAGUE

Compared with a similarly-sized Crucial MX100, the ARC 100 has the measure of it. Not necessarily in the read speeds, but it smashes the 256GB MX100 in the write performance. That's mostly down to the density of NAND. The MX100 uses 128Gb modules, which is fine on the top 512GB version as it fills out the memory channels on the controller. But on the lower capacity drives there are fewer memory chips compared to the number of 64Gb modules in

the ARC 100. That means these OCZ drives end up with better parallel storage performance overall.

But historically, OCZ drives have been blighted more by consistency problems than price or straight-line performance. The good news is that the consistency of even this budget drive is second only to the SanDisk Extreme Pro, which costs \$50 more. Using PCMark's command line storage consistency test, hammering the drive over 24 hours, the ARC 100 performs significantly better than the Samsung 840 Pro and is way ahead of the Crucial MX100. And those are both the half-terabyte versions.

This \$100 drive is so robust we can forgive it not being on top in the straight performance metrics. The difference between those sequential speeds wouldn't be noticeable during standard usage, but if you're using data-intensive applications on your drive, the consistency differences would be. Price is such a key factor in SSDs that it's important for OCZ to be on that level. But its consistent performance is even more vital. —DAVE JAMES

BENCHMARKS

	OCZ ARC 100	Crucial MX100	Samsung 840 EVO
Sequential Read Performance			
AS SSD (MB/s)	433	499	496
4K Random Write Performance			
AS SSD (MB/s)	98	106	82
Storage Consistency			
PCMark 08	4,807	4,317	4,291

Best scores are bolded.

VERDICT

9

OCZ ARC 100 240GB

■ **ARC DE TRIOMPHE** Great value; reliable; highly consistent performance.

■ **MISSED THE MARK** Not the fastest.

\$100, www.ocz.com

SUBSCRIBE

GO TO UFC.COM/MAGAZINE
TO SUBSCRIBE NOW!





The new Mugen Max is a good option for a quiet PC in a standard sized case.

Scythe Mugen Max

Scythe's latest addition is large, quiet, and performs well

THE NEWEST ARRIVAL in Scythe's high performance Mugen range is the Max—an apt name for such an impressively sized lump of a PC cooler. Perhaps the most surprising thing about the Mugen Max is its relative lightness. Despite its 5.7 x 3.4 x 6.3-inch size (and that's without the 5.5-inch fan), it weighs in at 1.6lb. That may sound a lot, but for a cooler of this size you'd normally be looking at something around 2lb.

The cooler block's contact plate is made from nickel-plated copper, as are the half dozen 6mm heatpipes that run through it (these heatpipes are not in direct contact with the CPU). To aid cooling even more, there are a couple of small heatsinks built into the top of the CPU block itself, which feed through a 39-finned cooling stack.

In a clever bit of design from Scythe, the cooling plate has been moved a little off-center, which should allow for more clearance for the taller memory modules currently available. However, every silver lining has a cloud and this design makes mounting the cooler a bit problematic.

The first part of the process—fixing the motherboard backing plate and the cooler mounts—is a doddle, aided by the simple but thorough single sheet of instructions.

However, when it's time to fix the cooling matrix using the central mounting bar, things get tricky. Although one fixing nut is very easy to reach, the other one is a complete pain—especially if some of the motherboard's VRMs are in close proximity to the CPU socket. Scythe supplies a little spanner for the job, but attempting to hold the cooler in place while simultaneously trying to get the nut started would quite frankly test Gandhi's patience. By far the easiest way is to pass a screwdriver through a hole in the cooling stack, but you'll be needing a long-shafted job to get to the fixing nut. No innuendo intended.

SLOW AND STEADY

To keep the noise down, Scythe has used one of its own GlideStream 140mm (5.5in) PWM fans. A large fan like this serves two purposes: it allows a large volume of air to be shifted around (Scythe quotes 97CFM of air) helping to keep things chillier, and because it spins more slowly than a smaller fan, it's very quiet. In this case it goes from just 500rpm up to 1,300rpm, with resulting quoted noise levels of between 12 and 30.7dBA. In normal use it's certainly very quiet. Near silent, in fact.

Both the large fan and cooling matrix give the Mugen Max pretty good performance, and thanks to that 140mm fan it goes about its job very quietly. It kept an i7-4770K at 24 C while idling, and with the CPU at 100 percent loading kept it at 60 C. When the CPU was overclocked to 4.5GHz, the cooler took things pretty much in its stride, keeping the CPU at 66 C when idling.

However, when pushed at 100 percent, the CPU did get a little on the warm side at 71 C. You might not want to run it for too long at this temperature, but even then the fan was barely audible. —SIMON CRISP



Scythe Mugen Max

■ **SILENT** Very quiet; light; clever design.

■ **VIOLENT** Mounting is tricky.

\$54, www.scytheus.com

SPECIFICATIONS

Intel Socket Compatibility	775, 1150, 1155, 1156, 1366, 2011
AMD Socket Compatibility	AM2, AM2+, AM3, AM3+, FM1, FM2, FM2+
Base Plate	Nickel-plated copper
Cooling Fans	1x 140mm (5.5in); dimensions 5.7 x 3.4 x 6.3-inch

BENCHMARKS

	Scythe Mugen Max	Rajjintek Ereboss	Cooler Master Seidon 240M
Stock-clocked Performance			
i7-4770K 100 Percent (°C)	60	49	47
Peak-to-idle Cool-down Performance			
i7-4770K @ 3.5GHz (sec)	134	55	16
Overclocked Performance			
i7-4770K @ 4.5GHz (°C)	71	61	52

Best scores are bolded.

gamesradar+

One-stop destination for games, movies, TV, and more!



New Channels: Movies, TV and Cool Stuff!

www.gamesradar.com

Fans of in-case cosmetics take note of the nice-looking sticks with heat spreaders.

SPECIFICATIONS

CPU Compatibility	Intel Core i7 "Haswell-E"
Configuration	4x 4GB
Frequency	2,400MHz
Latency	16-16-16-39
Voltage	1.2v
XMP Support	2.0



Crucial Ballistix Sport DDR4 16GB

Pizza and beers, or some premium DDR4?

HIGH-PERFORMANCE MEMORY is by far and away, without a shadow of a doubt, the most pointless PC component you can buy.

Hyperbolic but basically true? It's certainly the sentiment that any premium memory kit has to battle these days. The reason performance memory has become less relevant, of course, has been the demise of bus-based overclocking. With Intel's CPUs you either can't overclock, or it's done via the CPU multiplier, leaving the memory subsystem untouched.

Making matters worse, what we're dealing with here is a quad-channel kit for Intel's latest Haswell-E chips on the newly revised LGA2011 socket—and that's a platform with epic memory bandwidth overkill on the desktop to start with. It's really designed for multi-CPU servers. But in single-socket desktop trim with four channels, it's an embarrassment of bandwidth.

The idea that you're going to see significant benefits from increased memory bandwidth, then, seems fanciful. What's more, the most appealing thing about Intel's new Haswell-E chips is just how affordable the entry-level six-core CPU looks next to Intel's top quad-core for the LGA1150 platform. We're talking roughly \$50 for 50 percent more cores. Fantastic.

Unless, that is, you're ramping up the overall system cost with silly-money memory. If that's the context, is there any hope for the Crucial Ballistix Sport 2400 DDR4 16GB? Actually, there is.

CRUCIALLY UNNECESSARY?

That's because the price Crucial wants is only a little extra. It's yours for \$255 versus around \$220 for a run-of-the-mill 4x 4GB Crucial DDR4 kit—so it might be worth it. Indeed, if internal cosmetics count, then

the \$35 gets you some nice-looking sticks with heat spreaders, not cheapo items. Meanwhile the headline specs include triple-16 CAS latencies and an XMP profile setting of 2,400MHz (default for the new LGA2011 platform is 2,133MHz).

On the subject of latencies, running at the XMP 2,400MHz setting you get 16-16-16-39. That's slightly slower than the 15-15-15-36 latencies Crucial's standard achieves running at 2,133MHz. Knock the Ballistix Sport down to 2,133MHz and the result is 15-15-15-35, all pretty unspectacular compared to the 9-11-10-30 numbers Corsair's Dominator DDR4 can achieve. That said, the Ballistix manages it all, including a maximum overclock of 2,600MHz, at just 1.2v, which bodes well for the longevity of both this kit and your precious rig.

As for the benchmarks, well, there's zilch in it. The saving grace remains that modest price premium. But considering how little it adds in terms of maximum frequencies when overclocking, you might just want to spend that \$35 on a bonus night of pizza and beers. —JEREMY LAIRD

BENCHMARKS

	Crucial Ballistix Sport 2,400MHz	Corsair LPX 2,800MHz	Crucial DDR4 2,400MHz
Memory Bandwidth Performance			
SiSoft Sandra (GB/s)	49.63	54.59	49.26
Memory Latency Performance			
AIDA 64 (ns)	69	70	67
Memory Copy Performance			
AIDA 64 (GB/s)	56.8	62.2	57.2

Best scores are bolded.



Crucial Ballistix Sport DDR4

GOLD MEDAL Decent value for premium kit; good looking.

WOODEN SPOON Unimpressive benchmarks; we'd prefer a night out.

\$255, www.crucial.com

Microsoft Universal Mobile Keyboard

It's like cats and dogs sleeping together

MICROSOFT HAS LONG BEEN CRITICIZED for using an “embrace, extend—and extinguish” strategy across its business. You know, embrace a standard, extend it by adding new proprietary standards, and then extinguish the competition that can’t use the proprietary standards.

Well, we’re truly through the looking glass with Microsoft’s new Universal Mobile Keyboard, folks. This mobile Bluetooth keyboard is what you’d expect: rechargeable through micro-USB with a decent action but a little too compressed. There’s also a very clever cover that does double duty as a stand for your tablet, with two different viewing angles supported. The keyboard has the typical volume controls, multimedia buttons, and a compressed cursor layout as other mobile keyboards do. So far it’s a snore, right? What’s so unusual? Well, it’s clear that someone at Microsoft wearing an evil Mr. Spock goatee had a say in the design.

This Microsoft keyboard actually has an Apple Command key and an Android on it, while there’s not a single Windows key in evidence. Instead there’s a Home key that functions as a universal home key. On Android OS, it takes you to the home screen, in iOS it takes you to the homepage, and on Windows 8, it takes you to Metro. Perhaps we’re making too much hay of this but it tells you about the world we live in when Microsoft’s own peripherals team has support for Google OSes and iOS. What’s next, a Surface running Chrome OS?

UNIVERSALLY USEFUL?

The keys use an “island” design, which makes them look spacious, but the pitch width is 16.5mm compared to a standard 19mm keyboard. You’ll definitely feel cramped when typing. It’s functional for short typing assignments but we wouldn’t

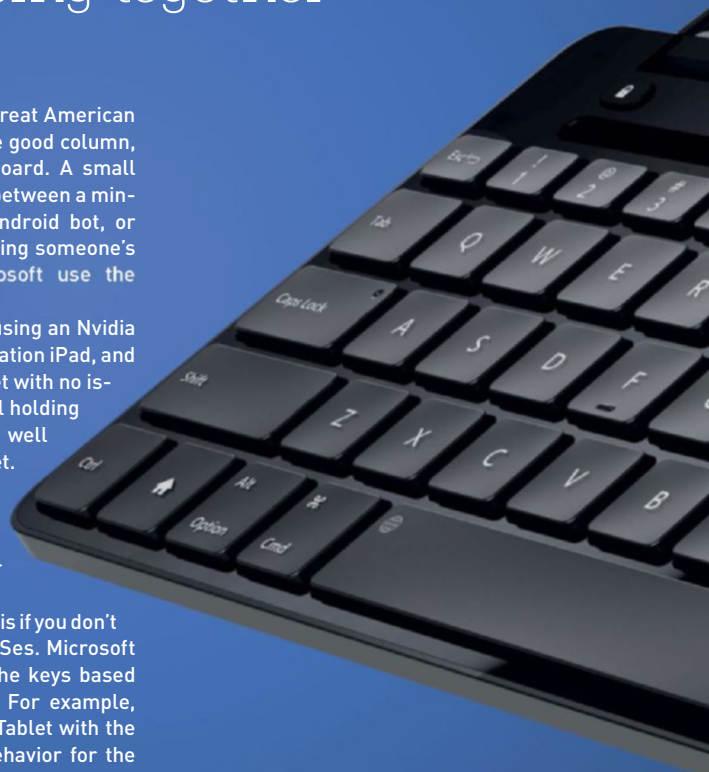
want to use it to write our Great American Science Fiction Novel. In the good column, it truly is a universal keyboard. A small slide switch lets you select between a miniature Windows logo, an Android bot, or “iPad, iPhone.” We’re guessing someone’s touchy about letting Microsoft use the Apple logo.

We tested the keyboard using an Nvidia Shield Tablet, second-generation iPad, and the original Windows 8 tablet with no issues. The stand worked well holding up even the large iPad, as well as the 8-inch Shield Tablet. Switching between devices was seamless and easy, and we can honestly see it as being a useful feature for multi-OS tablet users.

The only really tricky part is if you don’t intend to use it with three OSes. Microsoft has apparently remapped the keys based on the OS selector switch. For example, when we paired our Shield Tablet with the keyboard set to iOS, key behavior for the Home key and Escape key and Search key changed. We replicated the behavior using a Samsung Galaxy S5 running Android 4.4.4, as well. That means if you intend to buy this keyboard, to say, share it between two different tablets running the same OS, behavior will be a little funky. We understand why Microsoft would do such a thing but we also don’t think it’s that universal, either. It’s a rare home that has a Windows 8, iOS, and Android tablet. Most homes and users typically want to share a keyboard with a phone and tablet running the same OS, in our experience.

It’s a pity, really. There’s a lot we like, such as the well-thought-out stand that doubles as a cover, but its tight key pitch and funky remapping hurts its overall usefulness.

—GORDON MAH UNG



Microsoft Universal Mobile Keyboard

GET TOGETHER Handy stand; small; long battery life.

WE ARE THE WORLD Very tight key pitch; remaps keys.

\$79, www.microsoft.com



This MS keyboard shockingly has no Windows button, plus supports iOS and Android!

Far Cry 4 doing what it does best: chaos.



Far Cry 4

Mountains of fun, with exhilarating creativity

AJAY GHALE TRAVELS TO KYRAT, a fictional region of the Himalayas, to scatter his mother's ashes. But by a quirk of fate he finds himself in the service of the Golden Path, an army of freedom fighters founded by his late father. They're locked in a brutal civil war with Pagan Min, the despotic ruler of Kyrat, and it's up to you—the prodigal son—to free it from his tyranny.

It's a neat twist on the classic *Far Cry* setup. You are, as in earlier games, a tourist stranded in an exotic, dangerous place, but this time you have a more personal reason for being there. Ajay feels more like an empty vessel for the player than the last game's frat boy Jason Brody, but you still care about his story, because he's propped up by a memorable cast, including the two feuding leaders of the Golden Path, Amita and Sabal.

But let's take a moment to talk about Kyrat itself. This is a stunning landscape of fog-shrouded mountains, forested val-

leys, shimmering rivers, and rolling plains. While *Far Cry 3*'s Rook Island was vividly bright and colorful, here the palette is more muted. The Himalayan flora and fauna give it a very different feel, reminding us a lot of *Skyrim* in places. The map is large and open, but flanked by towering, snowcapped mountain peaks, and the scenery and atmosphere change subtly as you travel from the lowlands to the highlands. It's just a beautiful place to exist in.

BEAR THRILLS

It's also an insanely entertaining playground. We've had more fun here than we ever did in *Far Cry 3*'s tropical archipelago. Kyrat is full of sheer drops, mountains, cliffs, and deep valleys. It's remarkably varied and vertiginous, which lets you take full advantage of the wingsuit—now available straight away.

Gyrocopters have also been added, and they're awesome for buzzing around in.

There are new land and water vehicles, such as hovercraft and hilariously rickety tuk-tuks, but you'll spend most of your travel time up in the air. The grappling hook is another new addition, which Ajay can use to clamber up or rappel down vertical surfaces and swing across gaps. You can only attach it to pre-defined points, though, which is slightly disappointing.

Wildlife is an important part of the series, and Kyrat is teeming with exotic creatures, most of which want to kill you. There are elephants, rhinos, and black bears, monkeys, honey badgers, and eagles. This abundance of fauna makes your surroundings feel brilliantly alive, and random animal attacks are a constant source of amusement. Tigers will pounce on you, eagles grab you with their talons, elephants flip your car over, and killer bees swarm over you—sometimes simultaneously. But, equally, animals will attack your enemies, often to your advantage.



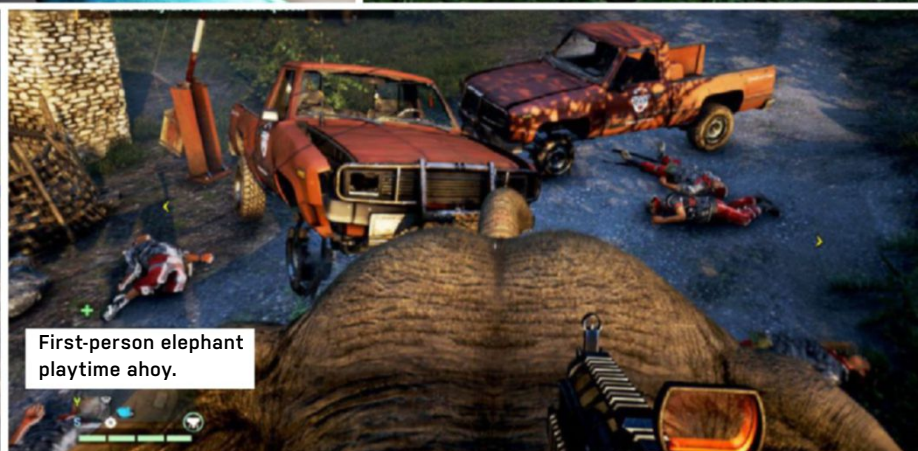
When you play co-op, your pal appears as this guy.



"Look what I found! Can we keep him? Can we?"



You'll grow to love the new gyrocopters.



First-person elephant playtime ahoj.

Like *Far Cry 3*, the game is split between story missions and outposts. The missions are bombastic, scripted, and large-scale, like an absurd action movie, while the outposts give you the opportunity to really play with the game's systems. Both are entertaining in their own way, but it's during outpost raids where things really get going.

How you approach and wipe out these enemy-controlled areas is up to you, and the game gives you a huge amount of tools to play with. Games often boast about player freedom when really all it amounts to is either shooting everyone noisily or shooting everyone stealthily; but the scope for creativity in *Far Cry 4* is often intoxicating, provided you have an imagination. The new fortresses are mega-outposts, filled with tough enemies and alarms.

EXTREME FISHING

Of course, this being an Ubisoft game, there are a million other icons littering the map. Some of these are fairly standard open-world fare, such as checkpoint races and collectables, but others are worth your time. The House of Chiffon challenges—where

you hunt rare animals for a creepy fashion designer—are a highlight, particularly the one where you go fishing by dropping C4 into a lake from a gyrocopter. Map-revealing towers are back, and each presents a unique platforming challenge. There's loads to do.

All of this—barring story missions—can be played with another person in co-op. This is one of the most enjoyable multiplayer experiences we've had for a while, and having another person on hand when assaulting an outpost only expands the already vast amount of ways to clear them. We didn't experience any issues, but have heard cases of people being kicked out and losing progress.

Far Cry 4's biggest weakness lies in its scripted missions. Amazingly, despite seemingly everyone hating them, *Assassin's Creed*-style tailing missions have made it into the game. There are also far too many insta-fail stealth bits. These are never fun and are totally at odds with the open-ended freedom of the outposts.

There are some really great moments in the story—especially your first trip to the dreamlike Shangri-La—but we can't help but feel the campaigns in these games

should be built around the outpost missions, and not separate, scripted entities. It's here where the game and its interacting systems really shine.

Another issue, but one we quickly got over, is familiarity. *Far Cry 4* is quite obviously an iteration of *Far Cry 3*, rather than any kind of progressive sequel. But then we loved *Far Cry 3*, so we don't care about that. There are more toys to play with, the world is more fun to traverse, the story is infinitely better, and everything just feels tighter and more focused. —ANDY KELLY

VERDICT
9

Far Cry 4

CRYING GAME Varied open-world; good multiplayer; huge scope for creativity; great new vehicles.

CRYING SHAME Disappointing missions, especially tailing missions.

\$60, far-cry.ubi.com, ESRB: M

You play as young rogue and stabbing extraordinaire Arno Dorian, a big fan of do-it-yourself guillotining.



Assassin's Creed Unity

Stunning visuals killed by technical failures

PARIS IN 1798. What a time to be alive. The streets are filthy with mud, blood, and gunpowder smoke. Starving citizens bully perceived enemies to guillotine stands. Guards grapple with anarchists. Above burn spiked heads. Below, French Tricolor flags lie stamped into the dirt. *Assassin's Creed Unity* recreates all of this with astonishing clarity and sets it within the most detailed city we've ever seen in a game. If *Unity* was about absorbing the ambience of a period of history, we could stamp a big "YES" on it. The full story is more complicated.

Unity is about exploring the city, jumping, and stabbing. The professional killer of this adventure is young rogue Arno Dorian. Born of wealth, he's driven into the Assassin order by tragedy and there uses his skills to seek revenge and win the affection of cherished childhood friend Elise. Naturally, there's also a convoluted plot involving the ongoing feud between the Assassins and the Templars, who are both manipulating the revolution for increasingly confusing reasons.

This is complicated only slightly by the return of the ongoing *Assassin's Creed* metaplot. In this game you're playing a VR product created by the evil Abstergo Industries, which is searching for the death site of a figure in Arno's life. The best thing about this is that it's delivered in brief, infrequent cutscenes and voiceover skits. No longer are you pulled from your adventures to roleplay a more boring person. Instead, the present day plot influences several quick but very entertaining interludes that leave your assassin faculties intact. We won't spoil them.

THE FRENCH CONNECTION

Almost the entire game is set in Paris and the return to a single-city setting reflects *Unity's* desire to strip down a series that's entertained many tangents. It's simply about assassinations now. And they're great.

The act of efficiently dispatching a target has been incidental to the series for too long, so we're glad *Unity* does it justice. Targets are hidden away in castles, prisons,

and palaces that you have to crack like a violent puzzle. Poised like a period Batman on some dark rooftop, Arno assesses the area to pick out gaps in defences. When the mission starts you're free to approach the target however you wish. Manipulating the sandboxes is great fun. We've whipped up starving crowds into a frenzy, set fire to sniper towers, and done other terrible things best left to discovery.

These missions are facilitated by a new stealth system. It finally has the crouch-walk the series has always needed, but there's a clunky cover system we found far too fiddly. Plus there's a new weapon—the phantom blade. It's a wrist-mounted mini-crossbow that lets you kill targets at range or send them berserk to cause a distraction.

The campaign is padded out with numerous set-up missions. While these are generally fine, you're still following NPCs along dramatic rooftops, stealing things from heavily guarded areas, and saving civvies from criminals—familiar stuff.



ABOVE Start each mission by surveying the scene, Batman-style, to work out what carnage you can cause.



ABOVE RIGHT There's a great selection of weapons at your disposal, from pistols and polearms to axes and clubs.

The close focus on everyday assassin business also puts more pressure on *Assassin's Creed's* core traversal systems, and it can't quite handle the artfully crooked geometry of Paris. There are now separate commands for freerunning up and down buildings, which is useful, but movement in all directions lacks precision. Simply climbing into a window can be a nightmare.

There are dozens of simple manoeuvres that should be effortless, but aren't. Look out for the assassin's greatest enemy, the small box, which Arno sometimes mounts as though it's the highest point in the world. Sure, 80 percent of the time things work nicely, but for a game so reliant on traversal it fails too often. *Assassin's Creed* has always had these problems, but the complex streets of Paris seem to compound them.

Combat has been refreshed, too, with good intent but mixed results. In *Black Flag* and *Assassin's Creed 3*, you were immortal. Not so in *Unity*. The counter button has been replaced by a parry command. Time it perfectly and Arno will execute a countering blow that will put the enemy off balance and open them up to brutal kill-moves. But Arno can only suffer a few blows himself before being run-through, and can quite easily be shot to death in the middle of a fight.

We liked Arno's fragility a lot—combat *should* feel dangerous—but it shouldn't feel quite so out-of-control. Ubisoft has said

the system is inspired by fencing, but it's remarkably sluggish. Our button presses seem lost, as if we're shouting instructions from a mile away. On the plus side there's a good variety of weapons. You can choose to fight with swords; long weapons such as spears; or big weapons like axes and clubs.

These slot into an overwhelming suite of customization options that let you choose Arno's hood, gloves, trousers, and coat. Different items confer varying bonuses to your toughness and stealthiness, but these don't make much difference until the twilight stages of the game. They're bought with in-game money you can earn by completing side missions, which vary wildly in quality.

BEAUTY AND THE BEAST

You can skip all that and buy weapons and armor with real money via a microtransaction system that's opportunistic and a bit depressing. After buying the game for \$60, you're invited to spend more money to play less of the game. Fortunately it's easy to ignore this, but the same can't be said for the awful in-game chests and items tied into *Unity's* companion app and *Initiates* webgame. *Initiates* chests are littered all over Paris. If you try to open one the game minimizes itself, opens your browser, and attempts to connect to the *Initiates* site. It's intrusive, shatters the fantasy, and holds back items and features from players who don't want to waste time on apps. Horrible.

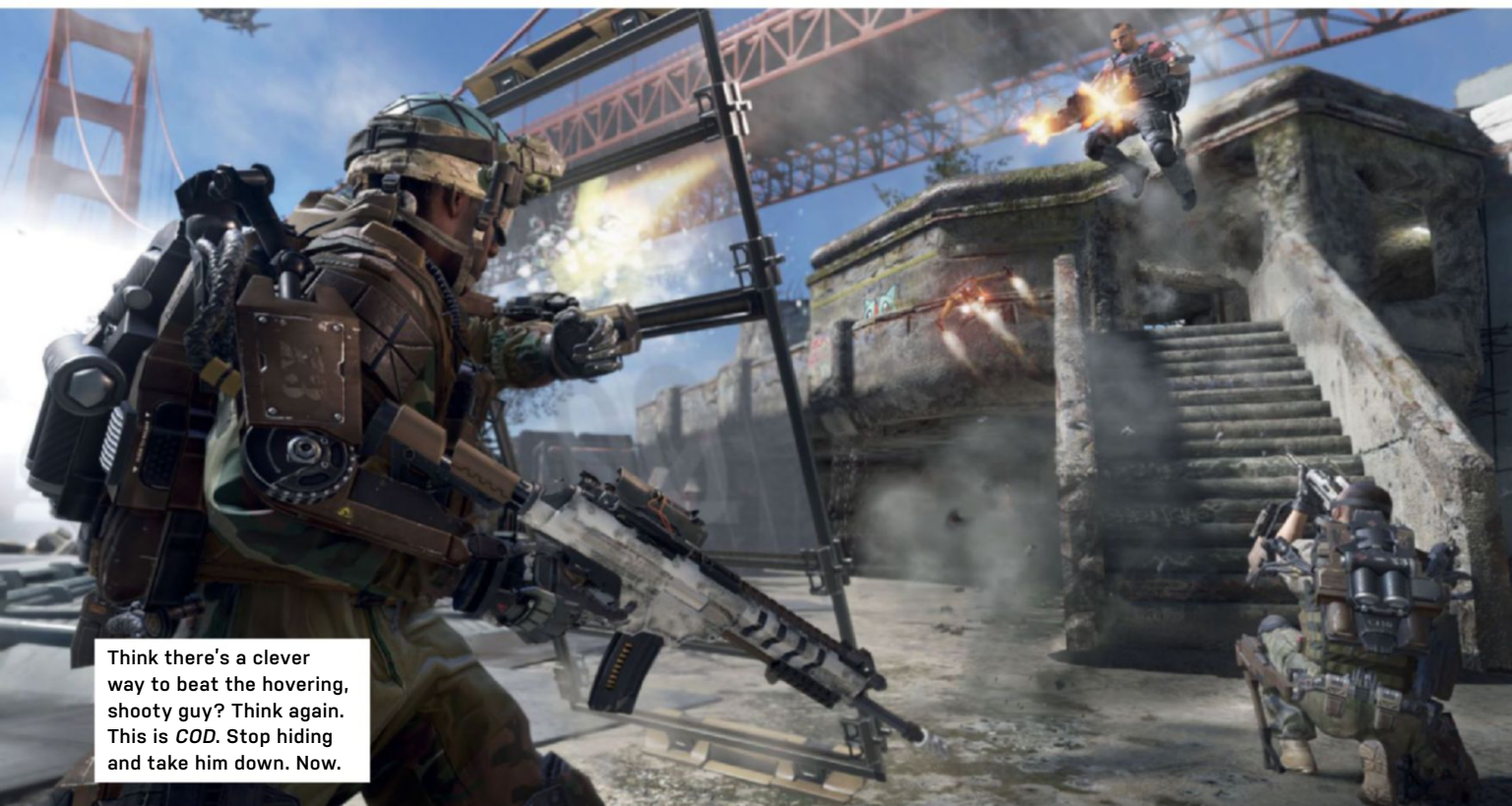
It's disappointing because there's real beauty to be found in *Unity*. Paris is stunning. We rarely gasp, but one came unbidden when we climbed a spire to see a patch of golden sunlight moving over the Notre Dame cathedral. Whether you're striding through slums or royal palaces, *Unity* realizes urban filth and glittering opulence with equal devotion. After finishing the game, we felt like we'd visited another place.

That makes us dearly want to recommend *Unity*, but unless you have a seriously good graphics card, we can't. It's fluid and gorgeous on our GTX 970, but on midrange cards like a 670, expect choppy frame rates. While our experience has been relatively clean, *Unity* is rife with widely reported bugs. The game also occasionally pauses for 15 seconds at random points. Plus it's crashed a few times. Others have reported disappearing faces, floating NPCs, and more severe stability problems.

The other huge failure is co-op. The new mode lets you summon up to three friends to run around exploring, or to engage in missions. We almost had fun in these, but not one game has passed without a disconnection error, or a wrongly placed objective marker, or a target not spawning, or numerous other errors. It just doesn't work.

If Ubisoft gets it patched up, *Unity* could become a perfectly enjoyable part of the *Assassin's Creed* canon. It's a solid campaign elevated by quality missions and an extraordinary setting that might just push the big number at the bottom of this review to eight or beyond. But with a big selling point out of operation, a raft of technical issues, performance problems, microtransactions, plus stilted combat and freerunning systems, *Unity*—in its current state—can only be considered a failed revolution. What a shame. —TOM SENIOR

VERDICT 6	Assassin's Creed Unity ■ VIVE LA REVOLUTION Stunning visuals; exciting missions; lots of customization options.
■ GET THE GUILLOTINE Too many technical issues; frustrating movement; awful webgame links.	
\$60, www.ubisoft.com ESRB: M	



Think there's a clever way to beat the hovering, shooty guy? Think again. This is *COD*. Stop hiding and take him down. Now.

Call of Duty: Advanced Warfare

The modern arcade shooter puts its *Ghosts* to rest

WELCOME TO A FIRST-PERSON shooting gallery smattered with nearly-on-rails vehicle segments, quicktime events, and slightly interactive storytelling. Yes, *Advanced Warfare* is like most other *Call of Duty* games. It sure is a lot better than *Ghosts*, though, and it introduces some neat gadgets. The most interesting are the Exo suits, which imbue their wearers with double-jumps, strafe dashes, and other special abilities.

Guns are littered everywhere and they're fun. Big, powerful, and varied, with some punching single shots through armor and others spraying corridors with death. The ballistics aren't very interesting (put mouse over head, tap left mouse button to make dead) but the animations, sounds, and dramatic death animations are addictive feedback. There's even a beam weapon—like a *Ghostbusters* proton pack, only it extracts ghosts from the living—and heaving its energy stream between targets, watching them drop and die, is disgustingly satisfying.

It's a walking, running, jet-jumping massacre, but all that power is constricted by a greater power: the script. There are moments when *Advanced Warfare* snaps the rigidity typical of *Call of Duty* campaigns—a brief, unguided stealth section, for example—but outside of those bits it's largely limited to who to shoot first.

At one point, for instance, we're pinned down. Could there be a clever solution? No. We need to run really fast and kill a few guys. *COD* says, "Hey, don't think so hard!" We don't even need to aim frag grenades, which rocket toward threats all on their own. Because it's the future.

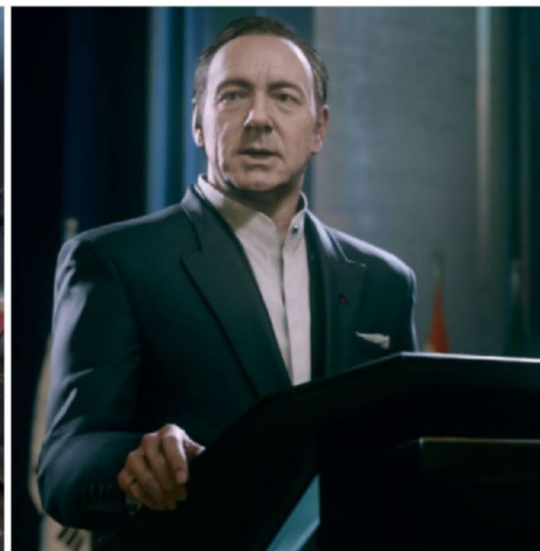
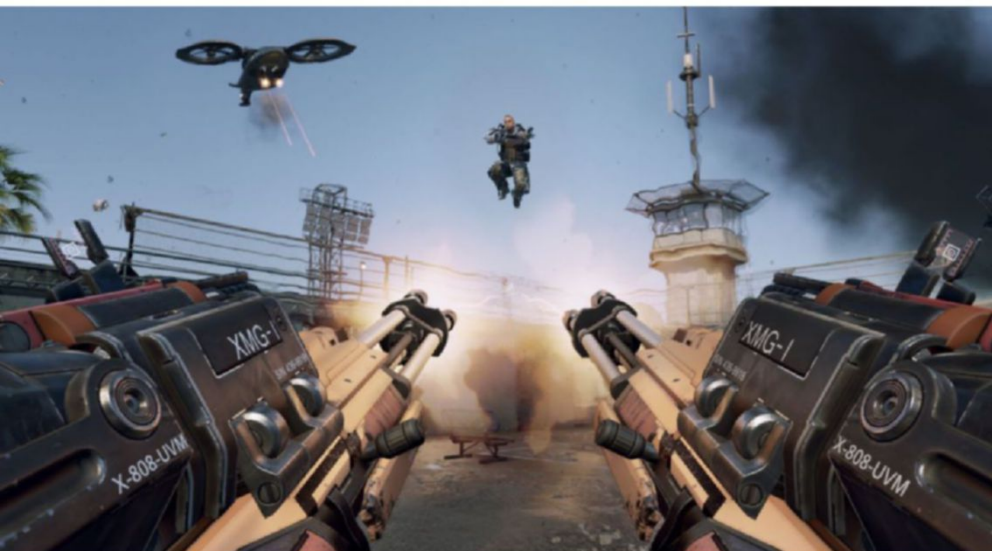
DUMB FUN

So we crouch behind cover, play with different weapons, aim for heads or crotches, depending on our mood. We can't stray too far ahead (despite being constantly told to move up), but we can bash around just enough to feel like we've got some freedom, jet hop-

ping up to ledges and punching dudes into next week. That's fun. All our critical bones want to shout at it for being so restrictive, but *Advanced Warfare's* eight-hour campaign is really hard to put down.

With Kevin Spacey in a lead role, it tells an enjoyably simple, predictable story of power and corruption. It's a potboiler plot, but it's an effective way to push us into improbable scenarios: hopping between buses on a freeway, clinging to a jet with magnetic gloves as it flies over Antarctica, speeding away from assailants on a hover bike. It's impossible to be bored when doing something spectacular and extravagant every 10 minutes.

Despite a few ugly textures, this is by far the best looking *Call of Duty*. The Antarctica level in particular is gorgeous. Our input feels predetermined, but the scenarios are some of the series' most thrilling. Flying a drone around a compound sniping bad guys through the windows is just great, dumb fun. We've come to enjoy *Call of Duty* campaigns



ABOVE Exo suits that let you double-jump and hover are a great new gadget.

ABOVE RIGHT Spacey is great. Obviously. But *House Of Cards* this ain't. The plot exists to set up the next slice of dumb fun.

for what they are: modern arcade run-and-guns. This is what *Contra* looks like in 2014, like it or not.

Our biggest complaint is that *Advanced Warfare* slacks on some of the basics. We're always faster than the squadmates we're supposed to follow, constantly bumping into them. Some objects have physics while others don't—we get stuck in the geometry once while under attack from a sniper. Plus the audio keeps desynchronizing from the video in cutscenes, so Kevin Spacey's mouth moves a good second after he's done saying something Very Serious.

Worst of all, we have to restart the game twice to finish the final mission because a bug prevents us from sliding under a closing door. That's really frustrating. When it finally works, it doesn't feel worth it. We enjoy the cutscenes, but we don't grow attached to any characters, or really give a damn about who lives and dies. *Advanced Warfare* whimpers into the credits. But hell, we do have fun, even if it's shallow.

Now for some good news. *Advanced Warfare*'s multiplayer is much better than *Ghosts*'. The weapons are more fun, the maps are more colorful, interesting, and better designed, plus the progression system is far superior. The campaign's Exo suits show up here, along with their jet-assisted double jump. But movement is less fun than in *Titanfall*, which has more liberal jetpack

jumps, bigger, taller maps, and wall-running chains. Even so, the Exo suits do make for some fun cat-and-mouse chases. They also have special abilities, with the cloak ability probably being the most effective. But matches just move too fast to worry about extras, like holding out an energy shield or muting footsteps. We like the hover ability, though. It lets you float for long enough to confuse the hell out of everyone below.

These abilities, as well as perks (move faster, be invisible to sensors, that kind of thing), special grenades, and weapon attachments, are unlocked as you earn experience and ranks, as usual. New equipment is also unlocked in "supply drops," which are acquired during matches.

We really like that you can customize the look of your soldier: male or female, with multiple faces and a ton of gear. We like looking cool. More importantly, there are now weapon variants to collect, so while there are only six assault rifles, for instance, there are multiple versions of each. Plus a slick new shooting range lets you play with your toys between matches.

CIRCLE OF DEATH

Extended stand-offs are rare, because even if the guy in front of you doesn't score the three-or-so chest shots needed to kill you, there is always someone behind you, waiting to slap the back of your neck with a combat knife. If you're behind someone, and you kill them, you'd better turn around, because there's someone behind you, too. And there's someone behind them! And so we all turn around and around and around. It's dizzying and stressful. The guns are fun to use but some feel superfluous. We find the best players in any given round stick to the basics: assault rifles and submachine guns.

We have a few technical complaints, and they are serious. We've crashed out of

matches three times, and though we haven't had many major performance problems, we're seeing a lot of ugly reports on forums. We've experienced irritating frame rate drops in many matches—and that means death—he was over there, but bam! Now he's standing over your body. We expected dedicated servers at launch, but there are none. Apparently they're on the way. We'd wait for that before buying.

We're used to these kinds of problems in *Call of Duty*, but that doesn't make them OK. And while *Advanced Warfare* is much better than *Ghosts*, it still doesn't rank highly for us among other multiplayer shooters.

Call of Duty remains a churning sea of adolescent sharks for whom new players are chum. The first several hours are frustrating as hell. After eight hours we have some teeth of our own, but chomping down is more instinct than fun. You can play round after round, hoping for little moments of victorious slaughter and the next set of unlocks, but you're never really sure why you let the timer tick down to the next round. *Call of Duty* remains comparable to the carbonated corn syrup it partners with every year: it's the Mountain Dew of shooters. We start drinking it. We're not sure we like it, but we just keep on drinking until we're all jittery and agitated. Then we can't sleep. So screw it, let's drink some more. —TYLER WILDE



Call of Duty: Advanced Warfare

KEYSER SÖZE Looks fantastic; Kevin Spacey; lots of fun; the multiplayer is some of *COD*'s best.

VERBAL KINT Too predictable; not enough freedom; experienced some crashing and framerate plummeting in multiplayer.

\$60, www.callofduty.com ESRB: M

LAB NOTES

TUAN NGUYEN EDITOR-IN-CHIEF



Where Is Silicon Valley?

Innovation on a turtle's back

I JUST ACCEPTED A JOB AT MAXIMUM PC.

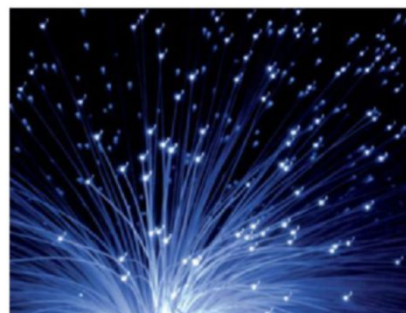
The team is amazing. The company is cool. The job? Fantastic. What more can one ask for, right?

After spending a little bit of time in the Bay Area, otherwise known as Silicon Valley, I realized the center of the universe for technology has terrible Internet access services. One would think that the place where innovation in technology happens would also be the place where the fastest access speeds are available—sadly, it's the exact opposite.

I've been living in Los Angeles for the last couple of years, and for the past two years, I've been on a 300Mb connection, and that's in both directions. My last year in LA gifted me with a blistering fast 500Mb connection. Residents of the San Francisco area would be lucky to experience one-tenth of the speeds I had in LA.

So, what's going on? Despite all the crazy innovation that happens around here, the Bay Area is heavily influenced by several factors: access monopoly, terrain, legacy infrastructure, and politics. Apparently, Comcast holds a choking grip on the area, with AT&T following fairly close behind. It's just sad. Granted, relative to other places around the United States, speeds here aren't too bad—an average of 20 to 30 megabits per second.

However, when you compare this to other regions around the world, and San Francisco's neighbor to the south, it becomes obvious that we have a problem with large Internet service providers and their control. It's not that I don't appreciate having some form of broadband, it's just that for the area—the technology hub of the world, supposedly—it's abysmal.



Fiber? You wish!

On the line where my previous community in LA requested my reason for relocating, I indicated that I had moved for fiber Internet. Sounds crazy I know, but I would do it again in a heartbeat.



JIMMY THANG

Online Managing Editor

It seems like gaming laptops missed the boat on 2560x1440 resolution displays. In this month's cover story, we had to hook up our ROG G751 to a separate 2560-resolution monitor to run those tests. In general, we've never had a 2560-resolution gaming laptop come through our Lab.

Sure, we're now seeing some 3K and 4K displays on

notebooks, but really, mobile GPUs are not equipped to game at those resolutions, not even the super-powerful GTX 980M. Plus, UHD displays have scaling issues and programs like Chrome look like crap on them. But 2560? There are no scaling issues and it would have been a perfect pairing with this month's G751. *Sigh* C'est la vie.



TOM MCNAMARA

Technical Editor

While I'm a PC guy, I also like to dabble with consoles. At the least, my declaration of the PC's superiority needs to come from experience not rhetoric. So I picked up an Xbox One bundle on sale, plus the Master Chief Collection, which fascinated me.

Here is Microsoft's flagship game franchise, yet the original games are incompat-

ible with Microsoft's flagship gaming platform. When I can use DOSBox to play a game I purchased 25 years ago, the contrast is disorienting. There are valid reasons, but it puts the long-term value proposition in stark relief. Thanks to backward-compatibility in hardware and software, I don't need to painstakingly preserve aging devices or aging media.

First Look: Sixense Stem System

This may be the best way to control virtual reality

WHILE VIRTUAL REALITY HEADSETS are going through a renaissance period, VR controllers are still stuck in the Wild West. Many companies are trying to find the best ways to interact in these virtual worlds, but unfortunately, there's no clear method to do it quite yet. To be fair, coming up with a solution that allows people to reach out into virtual worlds to pick up things with their hands is no easy task, but if anyone's got a chance at solving the puzzle, it's Sixense.

If the company's name sounds familiar, it's because Sixense teamed up with Razer back in 2011 to develop the Wii remote-like Razer Hydra motion controller. While the device failed to make a big splash at first, once the Oculus Rift development kit units started rolling out, the Razer Hydras quickly flew off shelves. They are now no longer in stock and go for a pretty penny on eBay.

The main issue currently holding back the Hydra is its wires. This isn't the case with the company's new STEM controllers, however. Not only is the device wireless, but Stem aims to offer a 1:1 movement experience with just 4.2 milliseconds of latency. And, while the Oculus Rift is intended to be used while sitting, the Sixense Stem is aiming to extend VR to standing experiences. It does this by foregoing DK2's camera and instead opting for what the company refers to as its Stem pack. The Stem pack looks like a laptop battery that's anchored on to the backside of the Rift's headstrap. By doing this, it provides a much greater range of movement and users don't have to deal with camera line-of-sight issues, which is currently a problem with the DK2.

We had a chance to try the Stem at the company's Los Gatos home and got to play a variety of demos, the first of which was the awesome lightsaber demo. The Stem System has a docking station for the controllers, and when you pick one up, you also pick up a virtual lightsaber within the demo. Flicking the virtual blade to turn it on felt incredibly immersive. Simply put, waving it about just felt right. Toward the end of the demo, we got to deflect lasers from a droid and felt like Luke Skywalker on Tatooine.

The controller is similar to a Wii-mote, but wraps around your knuckles.

The second demo we tried took us to a shooting range. Firing felt accurate, and you could even use the in-game sights on top of the pistol to aim. It reminded us of Wii bowling, albeit in a more violent fashion.

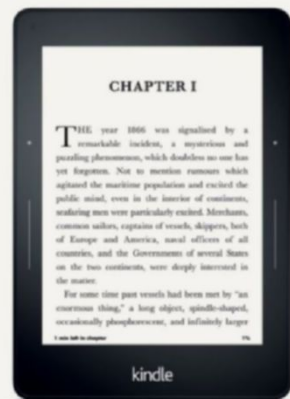
The last demo was one in which we walked around a virtual office using one of the Stem controller's thumb sticks. Playing it standing up, we experienced some locomotion issues, in that our eyes were telling our brain that we were walking forward, but our body was not. It was definitely dizzying and goes back to the issue that properly nailing down VR controls is a tough problem to solve. Sea-leg issues aside, it felt great swiping books off of book shelves.

Beyond VR, Sixense also believes the controllers can be used to shape 3D printed objects. The company is creating what it's billing as a "gamified two-point of control CAD-engine" called Make VR. You'll be able to use it without the Oculus Rift, the idea being that it will be an easy interface allowing you to create and edit 3D-printable objects.

The device is scheduled to ship early in 2015. Time will tell if it ends up becoming the VR controller of choice. **-JT**



Kindle Voyage 3G



It's lighter and thinner, so it's better!

IF YOU'RE AN AVID READER with a tablet or even a large phone, you may ask why you'd add an e-reader to your arsenal. The screens are slow, and they can't display video or even color, right? Well, what if you could read for hours without causing eyestrain, have battery life that lasted for weeks, and download your books over a 3G network without paying a monthly fee? Enter Amazon's flagship e-reader, the Kindle Voyage.

This upgrade from the Paperwhite boosts your pixels per inch from 212 to 300, so text looks extremely sharp, though some users have complained of uneven lighting. Its backlight adjusts automatically to the ambient light level and even dims gradually as your eyes adapt to low light. You can squeeze either side of the Voyage to turn pages, which vibrates in response, or you can disable that and navigate with touchscreen gestures instead. Speaking of screens, this one is now glass instead of plastic, and it's finely etched to reduce glare.

Downsides include no speakers or headphone jack, no bundled AC adapter, and no SD card slot; you have 3GB of usable space, forever. The Voyage is also expensive, with the 3G version coming in at nearly \$300 after sales tax. That's a lot for something to read stuff on. So if you're still using a Paperwhite, we can't justify a Voyage. But if you want an e-ink reader, this is arguably the best. **-TM**
\$269 (with ads), www.amazon.com

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Power Connections > LGA2011-v3 Motherboards > Gaming Upgrades

Hooking Up

I'm building the Turbo PC from the December issue. I am at a loss how to connect the Kraken X61 power connector. Should it be to the Gigabyte GA-X99-UD4 mobo? If so, how? Also, how did you get the X61 with the GA-X99-UD4 to fit inside the NZXT Phantom 530? —Pat

TECHNICAL EDITOR TOM MCNAMARA RESPONDS: Hi, Pat. The power connector plugs into one of your power supply's SATA cables. NZXT has a series of animated diagrams (<http://bit.ly/11YxZxU>) that walks you through it.

For the Phantom 530, you need to remove the plastic top of the case to reveal the metal frame. Mount the fans on the top of this frame, then put the radiator inside the case, right below the fans. The screw holes in the radiator will line up with the mounting holes in the case and the screw holes in the fans. The case will be resistant to having the plastic part removed—there are no fasteners, it's just pure force. But it's designed to not break when you do that.

Express Delivery?

For the newest socket (LGA2011-v3), is the Asus



The Gigabyte G1.Sniper Z97 features the Creative Labs Sound Core3D chip.

X99-Deluxe the prime way to go, or are there others as well? Also, do SATA Express drives of any type exist yet?

—Joe Rosenberg

TECHNICAL EDITOR TOM MCNAMARA RESPONDS: Joe, the Deluxe is the nicest-looking of the bunch, but I've seen a number of user reviews on Newegg that make me a bit leery of it. EVGA's X99 boards have been getting reviewed well, though, and they've some nice specs. We have an ASRock X99 Formula OC here in the office that packs in a lot of features for the price, and it's been reviewed well also (though I don't think we've taken that one for a spin yet).

If you're into high-end audio (by motherboard stan-

dards), several Gigabyte boards have the Creative Labs Sound Core3D chip. Its G1 boards also have a 600-ohm headphone amplifier.

As for SATA Express, M.2 devices are currently filling that niche. Standard SSDs have been selling well enough that manufacturers seem content to stay there until NVMe becomes inexpensive enough for mainstream production.

4K Video Cards

I'm upgrading my gaming computer this Christmas with a new 4K UHD monitor. I'll need a new video card and would like your recommendations on which is the best. I have no problem spending big for a card (\$2K is OK), so please let

me know which is the best. Here are my rig's specs: Cooler Master full-tower, Asus Rampage IV Extreme, Cooler Master Silent Pro Gold 1,200W, Core i7-3960X 3.3GHz, 32GB Ripjaws Z-series DDR3 2133 RAM, Sapphire HD 7970 6GB Vapor X video card.

—Shane Malone

ONLINE MANAGING EDITOR JIMMY THANG RESPONDS:

Given that you have a considerable budget to work with, your best candidates for 4K gaming come down to either two Titan Blacks or three GeForce GTX 980s in that price range. For 4K gaming, you'll want to have more VRAM to load the extra textures that the higher resolution demands, and between those two SKUs, a Titan Black has 2GB more VRAM than a 980. Having said that, however, we'd recommend going with three 980s. Not only is it cheaper, but overall you'd still get the same amount of VRAM (12 versus 12), and the 980 is just a better card for gaming than a Titan Black.

While we recommend getting three GeForce GTX 980s, if you wanted to stick with AMD, we'd recommend going with four 290Xs in CrossFire instead.

submit your questions to: comments@maximumpc.com

2600K Mobo

I recovered an Intel i7-2600K and would like to build a small form factor system or medium tower build around it to play with a few Linux distros. I need help choosing a motherboard that still supports this processor. Any ideas? —RG III

ONLINE MANAGING EDITOR

JIMMY THANG RESPONDS:

Intel's 2600K uses the LGA 1155 socket, so there are plenty of Mini-ITX options if you wanted to go small form. For something cheap, ASRock's H61MB-ITX goes for about \$50. For \$30 more, you can opt for Asus's P8H61-I R2.0, which supports eight-channel audio. If you're not hell-bent on Mini-ITX, MSI's \$45 H61M-P31/W8 is an affordable microATX choice that should cover your needs.

Snooze, You Lose

My rig consists of an Intel i7-3820 3.60GHz, 16GB

“

THERE'S NOTHING LIKE A LIT-UP CUSTOM LIQUID-COOLED SETUP AND A CLEAR SIDE PANEL TO IMPRESS YOUR FRIENDS.

of RAM, and a EVGA GeForce GTX 680 graphics card. I put it together two years ago. My budget was tapped out and I decided to wait to add another graphics card. However, the price of the GeForce 680 is still around \$600. Is the performance of the 680 GTX comparable to the 7- and 8-series cards? Is that why the 680 price has not been reduced?

—Danny Singleton

TECHNICAL EDITOR TOM MC-

NAMARA RESPONDS: The bad news is that the GTX

680 was discontinued in summer 2013. The good news is that your second GTX 680 doesn't need to be identical. But if the second card uses, say, 2GB of VRAM, and your first card has 4GB, then you will end up with 2GB total instead of 4GB (SLI does not add VRAM together, it just mirrors VRAM contents between your cards). Factory-refurbished 680s do still sometimes pop up on Amazon and Newegg so keep an eye out. ☺

[NOW ONLINE]

TAKE GREAT VIDEOGAME SCREENSHOTS

We've been featuring a "Graphics Porn" section on www.maximumpc.com, so thought it would be helpful to offer a primer on how to take great videogame screenshots. We walk you through the apps that work best, plus all the tips and

tricks you'll need. You might be surprised at how much creativity can go into getting a great screenshot. And, who knows? You might just get so good that we feature your work. Check them out online here: http://bit.ly/MPC_screenshots.



Get creative with these top screenshot tips.

Facebook Polls

Desktop vs. Laptop

In light of this month's cover story, we asked our Facebook friends which they would rather have: a high-end desktop or a high-end laptop. Here are some of our favorite responses.

Kevin Spring: Desktop, because it is far easier to upgrade and repair. Plus with display technology finally advancing, I don't like the idea of never being able to change my screen size/resolution. On top of that, gaming laptops generally don't have great portability or battery life, so I'll stick with a cheaper ultrabook and my custom-built desktop.

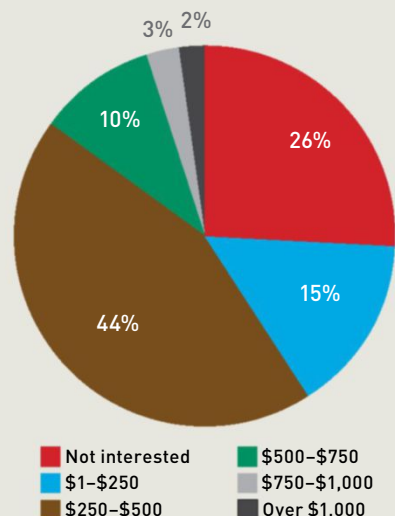
Nik Stahley: Desktop. Nothing like a lit-up custom liquid-cooled setup and clear side panel to impress your friends.

Matt Livingston: Desktop! Hardware upgrades are a whole lot easier, also it's a lot easier to set it up to your liking and your style of PC browsing/gaming. Laptops are convenient as far as mobility goes but there is nothing like sitting down at your own battle station and doing whatever.

Jay Dickens: Laptop, because I'm an adult. I have things to do and places to go. But I would like to perhaps play something better than a mobile game when I get there.

Callum Casey: I'd rather save my money and have a midrange of both. At that kind of price, you could get a nice ThinkPad and have change for a midrange desktop left over.

How much would you pay to upgrade to an eight-core CPU in your LGA 1150 motherboard?



Like our page at www.facebook.com/maximumpc

We've upgraded

NEW
SITE LIVE
NOW



- ✓ Designed to suit every screen
- ✓ Complete round-the-clock news
- ✓ The best PC reviews and features
- ✓ In-depth hardware coverage

PC GAMER.COM THE GLOBAL AUTHORITY ON PC GAMES

TAKE IT FROM A GEEK.™

THE BUILDS

BUDGET GAMER



MIDRANGE



INGREDIENTS

PART		PRICE
Case	NZXT Source 210 Elite	\$50
PSU	Corsair CX500M 500W	\$45
Mobo	Gigabyte GA-H97M-HD3	\$75
CPU	Intel Core i3-4150	\$120
GPU	Sapphire Radeon R9 280 100373L	\$160
RAM	2x 4GB G.Skill Ripjaws DDR3/1600 NEW	\$60
SSD	120GB Intel 530 NEW	\$70
HDD	Seagate Barracuda 1TB	\$60
OS	Windows 8.1 64-bit OEM	\$100

Approximate Price: \$740

ANOTHER MONTH goes by with the Radeon R9 280 still in the retail channel. No other video card performs as well at this price, so we're keeping it. If it's disappeared by the time you read this, the Nvidia GeForce GTX 760 is a good alternative. MSI's 280 appears to have dropped off the map, but Sapphire had one for \$160 as this issue went to print. We also scored 8GB of G.Skill RAM for \$60. Getting an SSD with good write speeds in this price range is not easy, but we found an Intel 530 Series unit that's rated for up to 480MB/s to replace the SanDisk Ultra Plus. The Intel Core i3 remains good value for gaming, and the H97 motherboard chipset provides a strong upgrade path.

INGREDIENTS

PART		PRICE
Case	Corsair Vengeance C70	\$108
PSU	EVGA SuperNOVA 850W G2 220-G2-0850-XR NEW	\$95
Mobo	Gigabyte GA-G1.SNIPER Z97	\$165
CPU	Intel Core i5-4690K	\$210
Cooler	Cooler Master Nepton 280L	\$100
GPU	Sapphire Tri-X Radeon R9 290 NEW	\$270
RAM	2x 4GB G.Skill Ripjaws DDR3/1600 NEW	\$60
Optical Drive	Samsung SH-224DB/BEB	\$20
SSD	Crucial MX100 256GB	\$116
HDD	Seagate Barracuda 3TB ST3000DM001	\$103
OS	Windows 8.1 64-bit OEM	\$100

Approximate Price: \$1,347

THE CORE I5-4690K is a spiffy all-round CPU, which has crept down \$30 to \$210. We also found a cheaper (but still great) Radeon R9 290 from Sapphire that replaces the model from MSI, allowing us to spend more on the power supply. This EVGA SuperNOVA's 850 watts and "gold" rating are enough to handle a second R9 290 later on. The Sniper Z97 mobo and Cooler Master Nepton 280L will allow some respectable overlocks, and you get a high-grade Creative Labs' audio chip as well. If you want SATA Express and M.2 instead, the MSI Z97 Gaming 5 is a fine alternative. The Crucial MX100 is aggressively priced for its specs, making it a popular choice around here.



IF YOU HAVE AN URGE TO SPLURGE on more than four CPU cores, Intel's X99 platform is your huckleberry. The Core i7-5820K has six cores with Hyper-Threading, for a total of 12 threads. It also supports 28 PCI Express lanes, while the platforms in the other two builds here are limited to 16. The extra bandwidth is handy for systems with more than two video cards and for PCIe-based storage. The Gigabyte GA-X99-UD4 motherboard is a good pairing after it's been updated to the latest BIOS, and 16GB of 2,400MHz DDR4 will be wicked fast. This 1,000W Thermaltake PSU uses an older design, but we've had good experience with its Toughpower Grand line. The 840 EVO might not be the fastest SSD on the market, but its SLC cache and 3D NAND containing three bits per cell make its TLC NAND comparable to more expensive technology. TLC may not have the statistical durability of MLC, but then neither do any of your hard drives. With the savings on the mobo and SSD, we can justify two GeForce GTX 980s.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART		PRICE
Case	NZXT Phantom 530	\$130
PSU	Thermaltake Toughpower PS-TPD-1000MPCGUS-1 1,000W	\$120
Mobo	Gigabyte GA-X99-UD4	\$230
CPU	Intel Core i7-5820K	\$385
Cooler	Cooler Master Nepton 280L	\$100
GPU	2x MSI GeForce GTX 980 Gaming 4G	\$1,200
RAM	4x 4GB Crucial Ballistix Sport DDR4/2400 4x4GB	\$234
Optical Drive	LG Blu-ray Burner WH16NS40	\$70
SSD	Samsung 840 EVO 500GB MZ-7TE500BW	\$190
HDD	Seagate Barracuda 3TB ST3000DM001	\$103
OS	Windows 8.1 64-bit OEM	\$100

Approximate Price: \$2,862

UPGRADE OF THE MONTH PNY 128GB TURBO USB 3.0 DRIVE



It's not new, but we've hit a threshold where you can get capacious and speedy external storage for surprisingly little money, in dimensions that will fit comfortably on a keychain. This unit also has a slider over the connector, rather than a sliding connector, enhancing its durability.

\$50 (street), www.pny.com

MAXIMUM PC (ISSN 1522-4279) is published 13 times a year, monthly plus Holiday issue following December issue, by Future US, Inc., 4000 Shoreline Court, Suite 400, South San Francisco, CA 94080. Phone: (650) 872-1642. Fax: (650) 872-2207. Website: www.futureus.com. Periodicals postage paid in San Bruno, CA and at additional mailing offices. Newsstand distribution is handled by Time Warner Retail. Basic subscription rates: one year (12 issues) US: \$19.95; Canada: US\$24.95; Foreign: US\$34.95. Canadian and foreign orders must be prepaid.

Canadian price includes postage and GST (GST #R128220688). PMA #40612608. Subscriptions do not include newsstand specials. POSTMASTER: Send changes of address to Maximum PC, P.O. Box 5852, Harlan, IA 51593-1352. Standard Mail enclosure in the following editions: None. Ride-Along enclosure in the following editions: None. Returns: IMEX Global Solutions, P.O. Box 25542, London, ON N6C 6B2, Canada. Future US, Inc. also publishes @Gamer, Crochet Today!, MacLife, The Official Xbox Magazine, and PC Gamer. Entire contents copyright 2015.

Future US, Inc. All rights reserved. Reproduction in whole or in part is prohibited. Future US, Inc. is not affiliated with the companies or products covered in Maximum PC. Reproduction on the Internet of the articles and pictures in this magazine is illegal without the prior written consent of Maximum PC. Products named in the pages of Maximum PC are trademarks of their respective companies. PRODUCED IN THE UNITED STATES OF AMERICA.

SAMSUNG

One Giant Leap Forward



SAMSUNG
Solid State Drive



The World's First 3D V-NAND SSD From Samsung

Go where no SSD has gone before with the SSD 850 PRO. Its unique 3D V-NAND technology gives it exceptional performance, with class-leading* 150 Terabytes Written (TBW) lifetime endurance backed by a 10-year warranty.

*Based only on consumer-class SSDs

© 2014 Samsung Electronics America, Inc. Samsung is a registered trademark of Samsung Electronics Co., Ltd.



WORLD'S MOST ADVANCED PCs.



Starting At:
\$1,495 ENGINEERED FOR **MAXIMUM PERFORMANCE.**

 **DIGITALSTORM** | **CUSTOMIZE NOW: WWW.DIGITALSTORM.COM**



The Digital Storm Logo, and 'World's Most Advanced PCs' are trademarks of Digital Storm.

Intel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of Intel Corporation in the U.S. and/or other countries.